(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 465 765 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.11.2024 Bulletin 2024/47

(21) Application number: **24176101.4**

(22) Date of filing: **15.05.2024**

(51) International Patent Classification (IPC):
H05B 45/50 *(2022.01)* ***H05B 47/11*** *(2020.01)*
H05B 47/19 *(2020.01)* ***H05B 47/20*** *(2020.01)*

(52) Cooperative Patent Classification (CPC):
H05B 45/50; H05B 47/11; H05B 47/19; H05B 47/20

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **15.05.2023 GB 202307205**

(71) Applicant: **F.W. Thorpe Public Limited Company**
Redditch Worcestershire B98 9HH (GB)

(72) Inventors:
- **Allcock, Mike**
  Redditch, B98 9HH (GB)
- **Waters, Robert**
  Redditch, B98 9HH (GB)

(74) Representative: **Swindell & Pearson Limited**
48 Friar Gate
Derby DE1 1GY (GB)

(54) A LUMINAIRE FOR AREA LIGHTING

(57) A luminaire for area lighting is provided. The luminaire comprises one or more lights, a plurality of driving circuitries and a controller. Each driving circuitry is configured to control the supply of power to any one of the one or more lights. The controller is configured to select one of the plurality of driving circuitries. The selected driving circuitry is operable to supply power to one of the one or more lights.

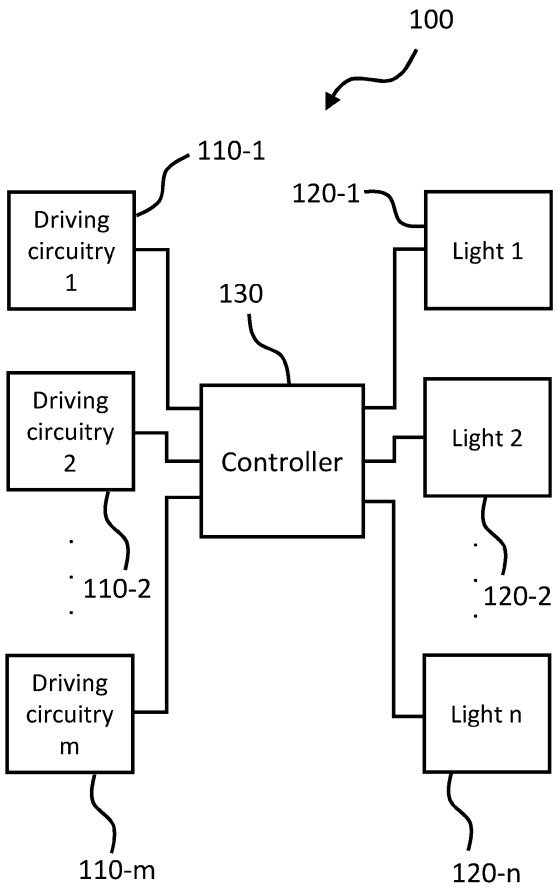

FIG. 1B

EP 4 465 765 A1

Description

TECHNOLOGICAL FIELD

[0001] Examples of the disclosure relate to a luminaire for area lighting.

BACKGROUND

[0002] Lighting is used to illuminate areas of interest when lighting conditions are poor. For example, lighting can be used to illuminate streets, tunnels, or public access, such as walkways.

BRIEF SUMMARY

[0003] According to various, but not necessarily all, examples there is provided a luminaire for area lighting. The luminaire comprises one or more lights, a plurality of driving circuitries and a controller. Each driving circuitry is configured to control the supply of power to any one of the one or more lights. The controller is configured to select one of the plurality of driving circuitries. The selected driving circuitry is operable to supply power to one of the one or more lights.

[0004] The controller may be configured to select a different driving circuitry from the plurality of driving circuitries after a predetermined length of time from selecting a currently-selected driving circuitry.

[0005] The luminaire may comprise a housing, and the controller may be housed inside the housing of the luminaire. At least one of the one or more lights may be at least partially housed inside the housing of the luminaire. At least one of the plurality of driving circuitries may be housed inside the housing of the luminaire.

[0006] The luminaire may comprise a light sensor. The controller may be configured to cause the selected driving circuitry to supply power to one of the one or more lights when a light level sensed by the light sensor is below a threshold.

[0007] The controller may be configured to stop the supply of power from the selected driving circuitry to the light when the light level sensed by the light sensor exceeds a threshold.

[0008] At least one of the one or more lights may have a power consumption between 10W and 200W. At least one of the plurality of driving circuitries may have an output power between 14W and 200W.

[0009] The luminaire may comprise a transceiver. The luminaire may be configured to communicate with an external user device via the transceiver.

[0010] The luminaire may comprise a plurality of lights and the controller may be configured to select one of the plurality of lights. The selected driving circuitry may be operable to supply power to the selected light.

[0011] The controller may be configured to select a different light from the plurality of lights after a predetermined length of time from selecting a currently-selected light.

[0012] The controller may be configured to diagnose a currently-selected light of the plurality of lights and a currently-selected driving circuitry of the plurality of driving circuitries by monitoring power dissipation across the currently-selected light and the currently-selected driving circuitry.

[0013] The diagnosing may comprise determining whether the currently-selected light and/or the currently-selected driving circuitry is faulty.

[0014] The controller may be configured to determine an input power supply to the currently-selected light and an input power supply to the currently-selected driving circuitry, and determine whether there is an open circuit configuration across the currently-selected light and/or the currently-selected driving circuitry.

[0015] The controller may be configured to select a different one of the plurality of driving circuitries than the currently-selected driving circuitry, based on the diagnosing of the currently-selected driving circuitry. The controller may be configured to select a different one of the plurality of lights than the currently-selected light, based on the diagnosing of the currently-selected light.

[0016] The luminaire may be configured to create a fault alert in response to the controller determining that one of the plurality of driving circuitries and/or one of the one or more lights is faulty.

[0017] The luminaire may comprise a transmitter. The luminaire may be configured to control the transmitter to transmit the fault alert.

[0018] The plurality of lights may be at least partially housed inside the housing of the luminaire.

[0019] The luminaire may be configured to adjust a configuration of the controller, any one of the plurality of driving circuitries and/or any one of the plurality of lights based on information received from the external user device via the transceiver. The configuration may comprise at least one of:

a power consumption of the controller, driving circuitry and/or light;
a length of time for using a selected light; and
a length of time for using a selected driving circuitry.

[0020] The luminaire may be configured to compile data regarding the controller, plurality of driving circuitries and/or the plurality of lights.

[0021] According to various, but not necessarily all, examples there is provided a method for area lighting. The method comprises: selecting one driving circuitry from a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of one or more lights; and supplying power to the light from the selected driving circuitry.

[0022] The method may comprise selecting one light from a plurality of lights, and supplying power to the selected light from the selected driving circuitry.

[0023] The method, prior to supplying power to the se-

lected light from the selected driving circuitry, may comprise: determining whether the selected light from a plurality of lights is in a working condition; and determining whether the selected driving circuitry from a plurality of driving circuitries is in a working condition.

[0024] If the selected light and/or the selected driving circuitry is/are determined to be faulty, the method may comprise: selecting another light from the plurality of lights and/or selecting another driving circuitry from the plurality of driving circuitries, and determining whether the selected another light and/or the selected another driving circuitry is/are in a working condition.

[0025] The method may comprise: creating a fault alert, wherein the fault alert includes information relating to the determined faulty light and/or faulty driving circuitry; and transmitting the fault alert.

[0026] The method may comprise: stopping the supply of power to the selected light from the selected driving circuitry; selecting a different light from the plurality of lights and determining that the selected different light is in a working condition; selecting a different driving circuitry from the plurality of driving circuitries and determining that the selected different driving circuitry is in a working condition; and if the selected different light and the selected different driving circuitry are determined to be in a working condition, supplying power to the selected different light from the selected different driving circuitry.

[0027] The method may comprise: if the selected different light is faulty, selecting a further different light from the plurality of lights and determining that the selected further different light is in a working condition; and if the selected different driving circuitry is faulty, selecting a further different driving circuitry from the plurality of driving circuitries and determining that the selected further different driving circuitry is in a working condition.

[0028] The controller may be configured to determine an input power supply to the currently-selected light and an input power supply to the currently-selected driving circuitry, and determine whether there is an open circuit configuration across the currently-selected light and/or the currently-selected driving circuitry.

[0029] According to various, but not necessarily all, examples there is provided examples as claimed in the appended claims.

[0030] While the above examples of the disclosure and optional features are described separately, it is to be understood that their provision in all possible combinations and permutations is contained within the disclosure. It is to be understood that various examples of the disclosure can comprise any or all of the features described in respect of other examples of the disclosure, and vice versa. Also, it is to be appreciated that any one or more or all of the features, in any combination, may be implemented by/comprised in/performable by an apparatus, a method, and/or computer program instructions as desired, and as appropriate.

BRIEF DESCRIPTION

[0031] Some examples will now be described with reference to the accompanying drawings in which:

FIG. 1A shows a schematic diagram of a luminaire;
FIG. 1B shows a first example diagram of connections between a plurality of driving circuitries, plurality of lights and a controller of the luminaire;
FIG. 1C shows a second example diagram of connections between one or more devices, the controller, and a plurality of driving circuitries of the luminaire;
FIG. 2A shows an example of the luminaire;
FIG. 2B shows the example luminaire with the controller as circuitry;
FIG. 2C shows a state diagram of the example luminaire connecting a first driving circuitry with a first light;
FIG. 2D shows a state diagram of the example luminaire connecting the first driving circuitry with a second light;
FIG. 2E shows a state diagram of the example luminaire connecting a second driving circuitry with the first light;
FIG. 2F shows a state diagram of the example luminaire connecting the second driving circuitry with the second light;
FIG. 3A shows a first flowchart for using the luminaire;
FIG. 3B shows a flowchart for diagnosing the driving circuitries and the lights;
FIG. 4A shows a first state diagram of the example luminaire when the first driving circuitry is faulty;
FIG. 4B shows a second state diagram of the example luminaire when the first driving circuitry is faulty;
FIG. 5A shows a first state diagram of the example luminaire when the first light is faulty;
FIG. 5B shows a second state diagram of the example luminaire when the first light is faulty; and
FIG. 6 shows an example use of the luminaire.

[0032] The figures are not necessarily to scale. Certain features and views of the figures can be shown schematically or exaggerated in scale in the interest of clarity and conciseness. For example, the dimensions of some elements in the figures can be exaggerated relative to other elements to aid explication. Similar reference numerals are used in the figures to designate similar features. For clarity, all reference numerals are not necessarily displayed in all figures.

DETAILED DESCRIPTION

[0033] Embodiments of the present disclosure relate to a luminaire and an associated method. Some of the examples below discuss a luminaire comprising a plurality of driving circuitries and a plurality of lights. It will be

appreciated that, in some examples, only the driving circuitry is selected and the luminaire may only have one light.

[0034] FIG. 1 shows an example of a luminaire 100. In particular, FIG. 1A shows a schematic diagram of the luminaire 100 and FIG. 1B shows a diagram of connections between components of the luminaire 100.

[0035] The luminaire 100 is for area lighting, i.e., illumination an area of interest. For example, the luminaire 100 may illuminate an area to improve lighting conditions, such as for drivers of vehicles, cyclists and/or pedestrians. The luminaire 100 may be an outdoor luminaire for providing lighting outdoors, including within tunnels. The luminaire 100 may be used for street lights, roads, amenity, public access or tunnels. The luminaire 100 may be one of a lamppost luminaire, a tunnel luminaire or a public access luminaire, such as a walkway luminaire.

[0036] The luminaire 100 comprises a plurality of driving circuitries 110 and one or more lights 120. Each of the driving circuitries 110 is configured to control the supply of power to any one of the one or more lights 120. Each of the lights 120 is for lighting substantially the same area. Each light provides lighting when supplied power from one of the plurality of driving circuitries 110.

[0037] Each driving circuitry 110 may be configured to control a voltage and/or a current supplied to any one of the one or more lights 120. In some examples, the luminaire 100 may be connected to a mains power supply, and each of the plurality of driving circuitries 110 is configured to adjust the power supplied to any one of the one or more lights 120. Each of the driving circuitries 110 may be configured to adjust the mains power supply to an operating range of each of the one or more lights 110.

[0038] Each driving circuitry 110 may comprise current source circuitry. Current source circuitry is electronic circuitry that delivers or absorbs an electric current which is independent of the voltage across it. In some examples, the driving circuitry 110 may comprise a passive current source circuitry where a resistor is in series with a voltage source. In some examples, the driving circuitry 110 may comprise an active current source circuitry where an active electronic component, such as a transistor, is used to compensate for current variations. In some examples, the current source circuitry may include a negative feedback to maintain a constant current.

[0039] In some examples, the one or more lights 120 may require a DC power supply rather than an AC power supply. In some examples, each of the driving circuitries 110 may further be configured to convert an AC power supply, such as a mains power supply, to a DC power supply. For example, each of the driving circuitries 110 may comprise a rectifier. The rectifier of the driving circuitry may convert an AC power supply to a DC power supply when the driving circuitry supplies power to one of the one or more lights. In some examples, one or more of the driving circuitries 110 may be configured to have an output power between 14W and 200W. In some examples, all of the driving circuitries 110 may have an output power between 14W and 200W. The plurality of driving circuitries 110 may be a plurality of electronic control gears. In some examples, the driving circuitries 110 may all be identical. In some examples, the plurality of driving circuitries 110 may be a plurality of DALI- or DALI-2-compatible driving circuitries, i.e., a plurality of driving circuitries each configured to control light emission according to the DALI or DALI-2 standard. In some examples, each of the driving circuitries may comprise a controller, where each of the controller of the driving circuitry is a low level controller, for example, configured to provide current source control and/or for implementing the DALI or DALI-2 standard.

[0040] In examples where the luminaire comprises a plurality of lights, the plurality of lights 120 may be adjacent one another in the luminaire 100. At least one of the one or more lights 120 may have a power consumption between 10W and 200W. In some examples, all of the lights may have a power consumption between 10W and 200W. It may be that at least one of the one or more lights 120 is a dimmable light. It may be that the plurality of the lights 120 is a plurality of dimmable lights. Each light may be individually addressable/controllable. In some examples, each light may be a single light emitter or a plurality of light emitters. In some examples, at least one of the one or more lights 120 may be a plurality of LEDs or a LED module. It may be that the each of the one or more lights 120 is a plurality of LEDs or a LED module. In such examples, at least one of the plurality of driving circuitries 110 may be a LED driver. It may be that each driving circuitry 110 is a LED driver. The at least one LED driver, or each of the LED drivers, may be a constant current LED driver. The at least one LED driver, or each of the LED drivers, may have near-field communication functionality. The at least one LED driver, or each of the LED drivers, may be DALI- and/or DALI-2-compatible. For example, at least one LED driver, or each of the LED drivers, may be a D4i LED driver.

[0041] The luminaire 100 comprises a controller 130. The controller 130 may be a high level controller. The controller 130 is configured to select one of the plurality of driving circuitries 110. In examples where the luminaire 100 comprises a plurality of lights, the controller 130 is configured to select one of the plurality of lights 120. The selected driving circuitry is operable to supply power to the selected light. The luminaire 100 may be configured to provide area lighting for a period of time controlled by a timer, photocell and/or a central management system. During such period of time, the selected driving circuitry and the selected light, or selected light, may be used constantly. For example, the luminaire may provide area lighting during low ambient lighting conditions (dusk and/or night) and stop providing area lighting during bright ambient lighting conditions (such as daytime). Therefore, the luminaire 100 may be configured to provide area lighting cyclically, such as according to a daynight cycle.

[0042] The controller 130 of the luminaire 100 is con-

figured to select between the plurality of driving circuitries 110. The controller 130 of the luminaire 100 may be configured to select between the plurality of lights 120, when the luminaire comprises a plurality of lights. The controller 130 may be configured to select a different driving circuitry from the plurality of driving circuitries, and/or a different light from the plurality of lights, after a predetermined length of time, i.e., selection time, from selecting a currently-selected driving circuitry, and/or from selecting a currently-selected light. The predetermined length of time, i.e., selection time, may be minutes, hours, or more. For example, the selection time may be 24 hours, and the currently-selected driving circuitry is used to supply power to the currently-selected light for 24 hours. After 24 hours, the controller 130 is configured to select a different driving circuitry and/or a different light for the next 24 hours. Therefore, the driving circuitries and/or lights are alternated every day.

[0043] In some examples, the controller 130 may be configured to select a different driving circuitry from the plurality of driving circuitries, and/or a different light from the plurality of lights when the luminaire comprises a plurality of lights, each time illumination is required from the luminaire 100, e.g., based on light levels sensed by a photocell. For example, the luminaire 100 may be configured to store data, e.g., in a memory of the luminaire 100 or of the controller 130, indicating which driving circuitry and which light was most recently used. When the luminaire 100 is required to provide illumination, the controller 130 may assess the stored data indicating the most recently used driving circuitry and select a different driving circuitry. The controller 130 may assess the stored data indicating the most recently used light from a plurality of lights and select a different light.

[0044] The selected driving circuitries and the selected lights may be constantly used for a long period of time, e.g., minutes to hours. When a single driving circuitry and a single light of the luminaire is cycled on and off at a high frequency (e.g., to account for required uses during the daytime and the night), thermal stresses in the driving circuitry and the light cause it to fail over time. By selecting a different driving circuitry and a different light at a low frequency (such as daily), the luminaire 100 advantageously provides additional time for driving circuitries and lights to recover after use therefore improving the lifetime of the luminaire 100. This results in a reduction in the duty cycle of each driving circuitry and each light, thus providing longer recovery times. This in turn reduces the thermal stresses experienced by the components when exposed to a cyclic routine of switching on and off without being provided the appropriate time to fully recover.

[0045] For example, the driving circuitries 110 may comprise at least one capacitor. When the driving circuitries convert an AC power supply, such as a mains power supply, to a DC power supply, the capacitor may, for example, be used to remove or reduce the output voltage ripple. Therefore, the capacitor may be a filter capacitor. This capacitor may fail if used too much without correct recovery times. Cycling between multiple driving circuitries provides additional time for the capacitors to cool fully. This reduces thermal stresses experienced by the capacitor which results in an improved longevity of the driving circuitries because the capacitor will have a longer lifetime.

[0046] The controller 130 may be configured to operate via the DALI or DALI-2 standard. For example, the luminaire 100 may comprise a two-way controls bus, such as a DALI or a DALI-2 bus (not shown in FIG. 1A, 1B or 1C), providing an additional connection between the plurality of driving circuitries 110 and the controller 130.

[0047] In some examples, such as those illustrated in FIGs. 1B, 2, 4 and 5, the controller 130 may be positioned between the plurality of driving circuitries 110 and the one or more lights 120. The plurality of driving circuitries 110 may each have built-in surge protection. The controller 130 may therefore be protected from surges by the built-in surge protection of the plurality of driving circuitries 110.

[0048] In some examples, the luminaire 100 may be connected, or connectable, to one or more devices 135 configured to communicate with and control the plurality of driving circuitries 110. In some examples, the luminaire 100 may comprise the one or more devices 135 configured to communicate with and control the plurality of driving circuitries 110 (as illustrated in FIG. 1C). In some examples, the controller 130 may be positioned between the plurality of driving circuitries 110, and the one or more devices 135 configured to communicate with and control the plurality of driving circuitries 110, as per FIG. 1C. Therefore, the one or more devices 135 configured to communicate with and control the plurality of driving circuitries 110 are connected directly to the controller 130, and are not directly connected to the plurality of driving circuitries 110. The controller 130 may therefore direct any communication from the one or more devices 135 to the selected driving circuitry, e.g., via connection 112. As a result, the one or more devices 135 may not be aware that the controller 130 is connected to more than one driving circuitry.

[0049] In some examples, the controller 130 may be powered by one or more of the plurality of driving circuitries 110. In the example of FIG. 1B, the same connection between the plurality of driving circuities 110 and the controller 130 may be used to supply power to the controller 130. In some examples, an additional connection (not shown) may be used to supply power to the controller 130. FIG. 1C illustrates an additional connection 114 which may be used between the driving circuitries 110 and the controller 130 to supply power to the controller 130. In some examples, the connection for supplying power to the controller 130, i.e., from one or more of the plurality of driving circuitries, may comprise a diode (not illustrated) restricting the supply of power from the one or more of the plurality of driving circuitries to the controller 130.

[0050] The controller 130 may require a power supply

of 10V to 40V, or preferably 20V to 30V, or preferably 24V. In some examples, the controller 130 power supply may be limited to between 10V and 40V, or preferably between 20V and 30V, or preferably 24V. The controller 130 may require a current supply of 40 mA to 80 mA, or preferably 50 mA to 70 mA, or preferably 60 mA. In some examples, the controller 130 current supply may be limited to between 40 mA and 80 mA, or preferably between 50 mA and 70 mA, or preferably 60 mA. In some examples, the controller 130 may be powered by one or more of the plurality of driving circuitries 110 via a two-way controls bus, such as a DALI or a DALI-2 bus.

[0051] The luminaire 100 may also comprise a fault sensor 140. The fault sensor 140 is configured to sense faults in any one of the plurality of driving circuitries 110, and in any one of the one or more lights 120. In some examples, the fault sensor 140 may be a part of the controller 130. The fault sensor 140 may comprise one or more contact fault sensors, such as ammeters, or one or more non-contact fault sensors, such as Hall sensors. The controller 130 may be configured to diagnose a currently-selected light of the plurality of lights 120 and a currently-selected driving circuitry of the plurality of driving circuitries 110. In some examples, the controller 130 may diagnose the currently-selected driving circuitry and the currently-selected light prior to use. In some examples, the controller 130 may diagnose the currently-selected driving circuitry and the currently-selected light during or after use.

[0052] The fault sensor 140 and/or the controller 130 may monitor power dissipation across the currently-selected light and the currently-selected driving circuitry. The controller 130 may be configured to determine whether the currently-selected driving circuitry and/or the currently-selected light is faulty, e.g., in response to data sensed by the fault sensor 140. The controller 130 may be configured to determine an input power supply to the currently-selected light and an input power supply to the currently-selected driving circuitry, and determine whether there is an open circuit configuration across the currently-selected light and/or the currently-selected driving circuitry. The controller 130 may be configured to determine whether there is a short circuit configuration across the light, or currently-selected light, and/or the currently-selected driving circuitry.

[0053] The controller 130 may be configured to determine whether excessive power, i.e., power exceeding an expected power, is drawn by the currently-selected driving circuitry and/or the currently-selected light. The controller 130 may be configured to determine whether a voltage and/or a current across the currently-selected light, and/or the currently-selected driving circuitry is outside pre-defined levels, e.g., in response to data sensed by the fault sensor 140. For example, the controller 130 may be configured to store values (i.e., pre-defined levels) of parameters, e.g., voltage and/or current, for the one or more lights and the plurality of driving circuitries during normal operation. The controller 130 may be configured to determine values of parameters, e.g., voltage and/or current, for the one or more lights and the plurality of driving circuitries during use, and compare such values with the stored values.

[0054] The controller 130 may be configured to determine whether the currently-selected driving circuitry is unresponsive to the controller 130, e.g., via a two-way controls bus.

[0055] The controller 130 may be configured to select a different one of the plurality of driving circuitries than the currently-selected driving circuitry, based on the diagnosing of the currently-selected driving circuitry (such as the currently-selected driving circuitry being determined to be faulty). The controller 130 may be configured to select a different one of the one or more lights than the currently-selected light, based on the diagnosing of the currently-selected light (such as the currently-selected light being determined to be faulty).

[0056] In some examples, the controller 130 may be configured to identify if a currently-selected light and/or a currently-selected driving circuitry fails during use, i.e., when the currently-selected driving circuitry supplies power to the currently-selected light and the currently-selected light provides illumination from the luminaire. Here, the controller 130 may be configured to select a new driving circuitry and/or a new light for resuming area lighting. The controller 130 may diagnose the newly-selected driving circuitry and/or the newly-selected light prior to illuminating the area with the newly-selected driving circuitry and/or the newly-selected light.

[0057] As described above, the luminaire 100 may be configured to cause the selected driving circuitry to supply power to the selected light and provide illumination for a length of time, defined as illumination time. In some examples, the illumination time may be determined by a light sensor, a timer and/or a central management system. In particular, the illumination time may be when to start and stop providing area lighting.

[0058] In some examples, the luminaire 100 may comprise a light sensor 150. For example, when the illumination time is determined by the light sensor 150, the light sensor 150 may be a photocell configured to detect ambient light levels. The luminaire 100 may be configured to illuminate the area of interest when the light level sensed by the light sensor 150 is below a threshold. In particular, the controller 130 may be configured to cause the selected driving circuitry to supply power to the selected light when a light level sensed by the light sensor 150 is below a threshold. For example, the light sensor 150 may sense that the ambient light level is dark and lighting from the luminaire 100 is required.

[0059] The luminaire 100 may also be configured to stop illumination of the area of interest when the light level sensed by the light sensor 150 exceeds the threshold. In particular, the controller 130 may be configured to stop the supply of power from the selected driving circuitry to the selected light when the light level sensed by the light sensor exceeds the threshold. For example,

when the ambient light sensed by the light sensor is enough such that illumination from the luminaire 100 is no longer required.

[0060] In some examples, the luminaire 100 may be connected, or connectable, to one or more additional sensors. In some examples, the luminaire 100 may comprise the one or more additional sensors 160, as illustrated in FIG. 1A.

[0061] In some examples, one of the one or more additional sensors 160 may be a presence sensor. The luminaire 100 may be configured to illuminate the area of interest in response to the presence sensor sensing a presence, such as a moving object, e.g., a pedestrian, a vehicle, or a bicycle. In some examples, the luminaire 100 may be configured to illuminate the area of interest during the illumination time and when the presence sensor senses a presence. The presence sensor may, for example, be a passive infrared sensor.

[0062] In some examples, the light sensor 150 and/or the one or more additional sensors 160 may be connected to a two-way controls bus, such as a DALI or a DALI-2 bus, of the luminaire 100. The light sensor 150 and/or the additional sensor/sensors 160 may be powered via the two-way controls bus.

[0063] The luminaire 100 may further comprise a communication interface 170. For example, the communication interface 170 may comprise a transmitter and/or a transceiver. The communication interface 170 may be configured to communicate with a timer and/or with a central management system. The timer may be used to determine when and for how long the luminaire is to provide area lighting. In some examples, the luminaire 100 may comprise the timer. In some examples, the timer may be an external timer, i.e., a timer external to the luminaire 100. The central management system may be configured to provide remote, dynamic control of the luminaire 100. For example, the luminaire 100 may receive instructions (e.g., the illumination time) from the central management system via the communication interface 170.

[0064] The communication interface 170 may be configured to communicate with an external user device, for example using short-range communication, such as near field communication (NFC) and/or Bluetooth®. It may be that the luminaire 100 is configured to communicate with the external user device via a transceiver of the communication interface 170. The external user device may provide instructions to the luminaire 100. For example, the instructions may include to use and/or not use a particular driving circuitry and/or light. It may include instructions altering the selection time. It may include instructions altering how the luminaire determines faults. It may include instructions altering when and in response to what the luminaire provides area lighting (e.g., changing from light levels sensed by a light sensor to instructions from a central management system).

[0065] In some examples, the luminaire 100 may be configured to adjust a configuration of the controller 130, any one of the plurality of driving circuitries 110 and/or any one of the one or more lights 120 based on information received from the external user device via the transceiver. The configuration may comprise at least one of a power consumption of the controller, driving circuitry and/or light; a length of time for powering a selected light; and a length of time for using a selected driving circuitry.

[0066] In some examples, the luminaire 100 may be configured to create a fault alert in response to the determination that one of the plurality of driving circuitries 110 and/or one of the one or more lights 120 is faulty. For example, in response to the fault sensor 140 sensing faults, or the controller 130 diagnosing a faulty driving circuitry and/or faulty light. In some examples, the luminaire 100 and/or the controller 130 may comprise at least one processor and at least one memory. The memory may store created fault alerts. The luminaire 100 may be configured to transmit the fault alert from the communication interface 170. For example, the luminaire 100 may be configured to control a transmitter, e.g., of the communication interface 170, to transmit the fault alert. The fault alert may be transmitted to a central management system and/or an external user device. One or more stored fault alerts may be communicated via the communication interface 170. For example, the luminaire 100 may transmit one or more stored fault alerts to the external user device when the external user device is in proximity of the luminaire 100.

[0067] The fault alert may comprise information relating to one or more faulty driving circuitries and/or one or more faulty lights. The information may include an identifier of the luminaire, an identifier of the faulty driving circuitry and/or faulty light, a date and/or timestamp of the determination of the fault.

[0068] In some examples, the luminaire 100 may be configured to compile data regarding the controller 130, plurality of driving circuitries 110 and/or the one or more lights 120. The compiled data may be stored in a memory of the luminaire 100 and/or of the controller 130. The compiled data may include information regarding the efficiency of the luminaire. For example, the compiled data may include hours each driving circuitry and/or light has been used or powered, a log of the input voltage supplied to each light, a log of the output voltage and/or current supplied from each driving circuitry, the energy consumption of each driving circuitry and/or light, a system status of the luminaire, and a fault log for each created fault alert. The luminaire 100 may be configured to transmit the compiled data, for example to the external user device.

[0069] In the illustrated example of FIG. 1A, the luminaire 100 may further comprise a housing 180. In some examples, the controller 130 is housed inside the housing 180 of the luminaire 100. In some examples, at least one of the one or more lights is at least partially housed inside the housing of the luminaire. In some examples, a portion of at least one of the one or more lights may extend, i.e., protrude, from the housing 180 of the luminaire 100. In

some examples, the housing 180 of the luminaire 100 may comprise a window, and the one or more lights are arranged such that the one or more lights provide lighting through the window of the housing 180. In some examples, the one or more lights 120, i.e., each of the one or more lights 120, may be at least partially housed, or wholly housed, inside the housing 180 of the luminaire 100.

[0070] In some examples, at least one of the plurality of driving circuitries 110 may be housed inside the housing 180 of the luminaire 100. In some examples, the plurality of driving circuitries 110, i.e., each of the plurality of driving circuitries 110, may be at least partially housed, or wholly housed, inside the housing 180 of the luminaire 100.

[0071] In some examples, the fault sensor 140 may be at least partially housed inside the housing 180 of the luminaire 100. In some examples, the light sensor 150 may be at least partially housed inside the housing 180 of the luminaire 100. In some examples, the one or more additional sensors 160 may be at least partially housed inside the housing 180 of the luminaire 100.

[0072] In examples where the luminaire 100 is a lamppost luminaire, the luminaire 100, for example the housing 180 of the luminaire 100, is specifically shaped to fit to a lamppost. In examples where the luminaire 100 is a tunnel luminaire, the luminaire 100, for example the housing 180 of the luminaire 100, is specifically shaped to be fitted inside a tunnel. In examples where the luminaire 100 is a walkway luminaire, the luminaire 100, for example the housing 180 of the luminaire 100, is specifically shaped to be fitted along a walkway. For example, the housing 180 of the luminaire may be specifically shaped to be fitted to a handrail or fitted to a vertical surface, such as a wall. In each case, 'specifically shaped' refers to fitting to a proprietary housing socket, and/or the housing comprising a proprietary connection bracket, and/or the luminaire comprising a proprietary power adapter.

[0073] In some examples, the luminaire 100 may be connected, or connectable, to an external switch (not shown). The external switch may be used to switch the luminaire 100 between an enabled and a disabled mode, where the enabled mode allows the luminaire 100 to provide illumination as described above and the disabled mode prevents the luminaire 100 from providing illumination. The external switch may be external to the luminaire 100, for example, external to the housing 180 of the luminaire 100.

[0074] FIG. 1B shows a diagram of connections between a plurality of driving circuitries 110, plurality of lights 120 and the controller 130 of the luminaire 100 as described above. The luminaire 100 illustrated in FIG. 1B comprises 'm' driving circuitries 110 and 'n' lights 120, although the luminaire 100 may comprise a single light. In particular, FIG. 1B shows that each driving circuitry 110-1... 110-m is connected to the controller 130, and that each light 120-1... 120-n is connected to the controller 130. As described above, the controller 130 is configured to select any one of the driving circuitries 110 to supply power to any one of the lights 120. In particular, there are *m x n* combinations of driving circuitry and light which the controller 130 may select from.

[0075] The luminaire 100 comprises a plurality of driving circuitries 110 and one or more lights 120, and may therefore continue to operate as desired even when one or more driving circuitries become faulty. In examples where the luminaire 100 comprises a plurality of lights, the luminaire 100 may continue to operate as desired even when one or more lights become faulty. In particular, the luminaire 100 provides a redundancy capability, and the controller 130 of the luminaire 100 is configured to reconfigure itself in order for the luminaire 100 to continue working even when a driving circuitry 110, and/or a light 120, becomes faulty. This advantageously improves the life expectancy of the luminaire 100 and reduces the maintenance costs. For example, the luminaire 100 may only need to be maintained and/or repaired either when all of the driving circuitries 110 are faulty, or when all of the lights are faulty 120. This is because the luminaire 100 may continue to operate correctly provided that at least one driving circuitry 110 and at least one light 120 remain operational, i.e., not faulty.

[0076] The aforementioned luminaire 100 has been designed as being reactive rather than predictive because a reactive design is advantageously more reliable. In particular, the driving circuitries and lights are only diagnosed when they are selected for providing area lighting. This results in a faster diagnosing time as not all the driving circuitries and lights need to be diagnosed at the same time. By having redundancies, the luminaire 100 only needs to report an issue when this redundancy capability has been removed, i.e., when only one driving circuit and/or one light are in working condition and all others are faulty.

[0077] FIG. 1C shows a diagram where the controller 130 is positioned between one or more devices 135 and a plurality of driving circuitries 110. Although FIG. 1C illustrates two driving circuitries 110-1 and 110-2, additional driving circuitries is envisaged. The light 120 illustrated in FIG. 1C may be one or more lights, such as one or more LED boards. In some examples, the light 120 may be a single light which may receive power supplied from any one of the plurality of driving circuitries 110, i.e., from the selected driving circuitry. In some examples, each driving circuitry 110 may be connected, or connectable, to a particular light of a plurality of lights, e.g., to a particular LED board of a plurality of LED boards. The selected driving circuitry 110 therefore supplies power to a particular light for area illumination.

[0078] FIGs. 2A and 2B shows an example of a luminaire 200. The luminaire 200 illustrated in FIGs. 2A and 2B comprises two driving circuitries (210-1 and 210-2), two lights (220-1 and 220-2) and a controller 130. The luminaire 200, driving circuitries 210, lights 220 and controller 230 illustrated in FIGs. 2A and 2B may be the same as described above in relation to FIG. 1, with only the number of driving circuitries and the number of lights of

luminaire 200 being limited.

[0079] In some examples, the luminaire 200 may comprise only one light and the controller 130 may be configured to select a driving circuitry 210 from the two driving circuitries to supply power to the light 220. The controller may be positioned either between the driving circuitries 210 and the light 220 (as illustrated in FIG. 2), or positioned before the driving circuitries 210 (i.e., in a similar manner as illustrated in FIG. 1C). The operation may be the same as that described below in relation to FIG. 5, where only one workable light is available.

[0080] FIG. 2B shows the luminaire 200 of FIG. 2A but the controller 230 is illustrated as a state circuit. Here, the controller 230 is illustrated as being capable of selecting between the two driving circuitries 210-1, 210-2 and the two lights 220-1, 220-2 of the luminaire 200. In particular, the controller 230 may enable the first driving circuitry 210-1 to supply power to the first light 220-1 via a first driving circuitry connection 240-1 of the controller 230. The first driving circuitry connection 240-1 of the controller 230 contacts a first driving circuitry node 250-1, which is connected to the first driving circuitry 210-1. A first light connection 260-1 of the controller 230 connects the controller 230 to the first light 220-1 via a first light node 270-1. In this configuration, the first driving circuitry 210-1 can supply power to the first light 220-1 via the controller 230.

[0081] The controller 230 can alternatively change either the driving circuitry connection 240 and/or the light connection 260. For example, the driving circuitry connection of the controller 230 may be changed to a second driving circuitry connection 240-2, which connects the controller 230 with the second driving circuitry 210-2. In a similar manner as above, this is via connection between the second driving circuitry connection 240-2 of the controller 230 with a second driving circuitry node 250-2.

[0082] The light connection of the controller 230 may be changed to a second light connection 260-2, which connects the controller 230 with the second light 220-2. In a similar manner as above, this is via connection between the second light connection 260-2 of the controller 230 with a second light node 250-2.

[0083] The examples illustrated in FIGs. 2A and 2B are limited to two driving circuitries and two lights. However, it is envisaged that the luminaire may comprise any number of driving circuitries and any number of lights (i.e., where the number of driving circuitries and the number of lights is not the same), where the controller can connect any one of the driving circuitries with any one of the lights.

[0084] FIGs. 2C to 2F show a state diagram of the luminaire 200 connecting each driving circuitry 210 to each light 220, such that each driving circuitry 210 may supply power to any of the lights 220. In particular, FIGs. 2C and 2D illustrate the first driving circuitry 210-1 connected to the first light 220-1 and the second light 220-2, respectively, and FIGs. 2E and 2F illustrate the second driving circuitry 220-1 connected to the first light 220-1 and the second light 220-2, respectively.

[0085] In FIG. 2C, the first driving circuitry 210-1 is connected to the first light 220-1 via the controller 230. In particular, the first driving circuitry connection 240-1 is connected to the first driving circuitry node 250-1, and the first light connection 260-1 is connected to the first light node 270-1. In this configuration, the first driving circuitry 210-1 may supply power to the first light 220-1.

[0086] In FIG. 2D, the first driving circuitry 210-1 is connected to the second light 220-2 via the controller 230. In particular, the first driving circuitry connection 240-1 is connected to the first driving circuitry node 250-1, and the second light connection 260-2 is connected to the second light node 270-2. In this configuration, the first driving circuitry 210-1 may supply power to the second light 220-2.

[0087] In FIG. 2E, the second driving circuitry 210-2 is connected to the first light 220-1 via the controller 230. In particular, the second driving circuitry connection 240-2 is connected to the second driving circuitry node 250-2, and the first light connection 260-1 is connected to the first light node 270-1. In this configuration, the second driving circuitry 210-2 may supply power to the first light 220-1.

[0088] In FIG. 2F, the second driving circuitry 210-2 is connected to the second light 220-2 via the controller 230. In particular, the second driving circuitry connection 240-2 is connected to the second driving circuitry node 250-2, and the second light connection 260-2 is connected to the second light node 270-2. In this configuration, the second driving circuitry 210-2 may supply power to the second light 220-2.

[0089] FIG. 3A shows a flowchart 300 of a typical use of the luminaire 200 of FIG. 2, and FIG. 3B shows a flowchart for diagnosing a currently-selected driving circuitry and a currently-selected light.

[0090] In block 310 of FIG. 3A, the controller 230 of the luminaire 200, in a first instance, selects a first driving circuitry from the plurality of driving circuitries and a first light from the one or more lights. The controller 230 diagnoses the first driving circuitry and first light, i.e., determine that the first driving circuitry and the first light are in working condition. In some examples, the controller 230 may select and diagnose the first driving circuitry before selecting and diagnosing the first light, or vice versa. Provided that the first driving circuit and the first light are determined to be in working condition, the selection of the first driving circuitry and the first light is maintained for a predetermined length of time, e.g., selection time t1. As described above, the selection time t1 may be minutes or hours, and may be 24 hours.

[0091] When the luminaire 200 is required to provide area lighting, i.e., during the illumination time, the first driving circuitry supplies power to the first light. This may be in response to light levels sensed by a light sensor, such as a light sensor of the luminaire, a timer or an instruction from a central management system.

[0092] In block 320 of FIG. 3A, the first light is then

depowered, e.g., deactivated such that it no longer provides area lighting, such as when area lighting is no longer required. For example, the luminaire 200 may provide illumination at night, and stop illumination during daytime.

[0093] As described above, the controller 230 is configured to select a different driving circuitry after the predetermined selection time t1, e.g., 24 hours. When the luminaire 200 comprises a plurality of lights 220, the controller 230 is configured to select a different light after the predetermined selection time t1, e.g., 24 hours. In some examples, before selecting a different driving circuitry and/or light, the controller 230 may be configured to assess any stored fault alerts to determine the number of available driving circuitries and/or lights, and selection if based on the determined available driving circuitries and lights. The controller 230 selects a different driving circuitry and a different light, and diagnoses the selected different driving circuitry and the light, i.e., determines that the selected different driving circuitry and the light are in working condition, see block 330 of FIG. 3A. Provided that the different driving circuitry and light are determined to be in working condition, the selection of the different driving circuitry and light is maintained for a second predetermined length of time, e.g., selection time t2, and illumination is provided from the light when required, and subsequently depowered (block 340) in a similar manner as described above. The selection times t1 and t2 may be of different lengths of time, or they may be the same.

[0094] In the illustrated example of FIG. 3A, the luminaire 200 comprises two driving circuitries and two lights, as described in relation to FIG. 2. Therefore, after selection time t2, the controller 230 is configured to select the first driving circuitry and the first light, i.e., returns to block 310 of FIG. 3A. However, in examples where the luminaire comprises additional driving circuitries and/or additional lights, the controller 230 may instead select and diagnose a further different driving circuitry and a further different light, see optional block 350 of FIG. 3A.

[0095] As described above, the controller 230 is configured to continue alternating the use of the driving circuitries, and lights, of the luminaire 200 for the different selection times (t1, t2...). It will be appreciated that any driving circuitry may be used with any light of the luminaire.

[0096] FIG. 3B shows a flowchart in relation to the controller 230 selecting and diagnosing a driving circuitry and a light. In particular, the controller 230 selects a driving circuitry and a light, see block 360. This may relate to block 310, 330 or 350 of FIG. 3A. The controller 230 then determines if the currently-selected driving circuitry and the currently-selected light are in working condition in block 370 of FIG. 3B. If so, the controller 230 maintains selection of the currently-selected driving circuitry and the currently-selected light and uses the currently-selected driving circuitry to supply power to the currently-selected light, block 375.

[0097] In block 380, if the currently-selected driving circuitry fails, i.e., is faulty, then the controller 230 is configured to select another driving circuitry. As described above, the controller 230 may be configured to create and transmit a fault alert. This may be created and transmitted before or after selecting the other driving circuitry. This selected other driving circuitry is diagnosed, i.e., the controller 230 determines if the selected other driving circuitry is in working condition (block 382). If so, the controller 230 maintains selection of the other driving circuitry and uses the selected other driving circuitry to supply power to the currently-selected light in block 384. If the selected other driving circuitry fails, the controller 230 is configured to select a different driving circuitry. This repeats until the controller 230 determines that a driving circuitry of the plurality of driving circuitries is in a working condition, or until the controller 230 determines that all the driving circuitries are not operational, i.e., faulty. If all driving circuitries are determined to be faulty, the controller 230 may transmit a critical failure alert, indicating that the luminaire 200 is no longer operational.

[0098] Diagnosing the driving circuitry may include determining whether there is an input power supply, e.g., a mains power supply, to the driving circuitry being diagnosed. If no output is detected from the driving circuitry but an input power supply is present, then the driving circuitry is determined to be faulty and a fault alert is created.

[0099] Diagnosing the driving circuitries may apply to when the controller is positioned between the plurality of driving circuitries and the one or more lights (as illustrated in FIG. 1B), or when the controller is positioned before the plurality of driving circuitries (as illustrated in FIG. 1C).

[0100] Similarly, if the currently-selected light fails, i.e., is faulty, then the controller 230 is configured to select another light, see block 390. This selected other light is diagnosed in block 392. In other words, the controller 230 determines if the selected other light is in working condition. If so, the controller 230 maintains selection of the other driving circuitry and supplies power from the currently-selected driving circuitry to the selected other light, see block 394. If the selected other light fails, the controller 230 is configured to select a different light. As described above, the controller 230 may be configured to create and transmit a fault alert. This may be created and transmitted before or after selecting the other light. This repeats until the controller 230 determines that a light of the plurality of lights is in a working condition, or until the controller 230 determines that all the lights are not operational, i.e., faulty. If all lights are determined to be faulty, the controller 230 may transmit a critical failure alert, indicating that the luminaire 200 is no longer operational.

[0101] FIGs 4A and 4B shows an example luminaire 400 where one of the two driving circuitries is faulty, i.e., a first driving circuitry 410-1 as depicted in dashed lines, and the two lights 420 are in working condition. The driving circuitries 410, lights 420 and controller 430 are otherwise the same as described above in relation to FIGs. 2 and 3.

[0102] In a first instance (FIG. 4A), the second driving circuitry 410-2 supplies power to a selected first light, i.e., first light 420-1. The luminaire 400 may be configured to use the first light 420-1 to illuminate an area for the illumination time. As described above in relation to FIG. 1, this illumination time may be based on light levels sensed by a light sensor of the luminaire, or a timer or a central management system in communication with the luminaire 400. For example, illuminating an area during dusk and night.

[0103] As described above, the controller 430 of the luminaire 400 is configured to select a different driving circuitry 410 and a different light 420 after a predetermined length of time, i.e., a selection time. The selection time may be, for example, 24 hours. As the luminaire 400 illustrated in FIGs. 4A and 4B only has one operational driving circuitry (i.e., the second driving circuitry 410-2), the controller 430 continues to use the second driving circuitry 410-2 and selects a different light 420, i.e., the second light 420-2. Therefore, in a second instance (i.e., FIG. 4B), the second driving circuitry 410-2 supplies power to the second light 420-2. In some examples, the controller 430 may be configured to store an indication, such as a flag, that the first driving circuitry 410-1 is faulty. The controller 430 may therefore assess whether any of the driving circuitries 410 has an associated flag, and the controller 430 may be configured to only select, and diagnose, a driving circuitry 410 which does not have an associated flag.

[0104] In a similar manner, the luminaire 400 may be configured to use the second light 420-2 to illuminate an area for the same length of time as the first light 420-1. After the selection time, the controller 430 of the luminaire 400 selects the first light 420-1 again.

[0105] This cyclic selection between the first light 420-1 and the second light 420-2 continues until one of the lights becomes faulty, or until the remaining driving circuitry 410-2 becomes faulty. In a similar manner as described above, the controller 430 may diagnose the second driving circuitry 410-2 and the lights 420 prior to each use. When the luminaire comprises one working driving circuitry and one working light, the luminaire may be configured to transmit a preliminary critical fault alert indicating that the luminaire no longer has redundancy capability (as it only has one working driving circuitry and one working light) and that maintenance may be required. A critical fault alert may be transmitted when no driving circuitries 410 and/or no lights 420 are operational.

[0106] FIGs. 5A and 5B shows an example luminaire 500 similar to the luminaire 400 as illustrated in FIGs. 4A and 4B. The difference is that FIGs. 5A and 5B shows an example where one of the two lights is faulty, i.e., a first light 420-1 as depicted in dashed lines, and the two driving circuitries 410 are in working condition. The driving circuitries 410, lights 420 and controller 430 are otherwise the same as described above. In a similar manner, the operation described in relation to FIGs 5A and 5B may also apply to examples when the luminaire only comprises a single light.

[0107] In a first instance (i.e., FIG. 5A), a selected driving circuitry, i.e., the first driving circuitry 410-1, supplies power to the second light 420-2. The luminaire 500 may be configured to use the second light 420-2 to illuminate an area for the illumination time. As described above, this illumination time may be based on light levels sensed by a light sensor of the luminaire, or a timer or a central management system in communication with the luminaire 500. For example, illuminating an area during dusk and night.

[0108] In addition, the controller 430 of the luminaire 500 is configured to select a different driving circuitry 410 and a different light 420 after a predetermined length of time, i.e., a selection time. The selection time may be, for example, 24 hours. As the luminaire 500 illustrated in FIGs. 5A and 5B only has one operational light (i.e., the second light 420-2), the controller 430 continues to use the second light 420-2 and selects a different driving circuitry 410, i.e., the second driving circuitry 410-2. Therefore, in a second instance (i.e., FIG. 5B), the second driving circuitry 410-2 supplies power to the second light 420-2. In some examples, the controller 430 may be configured to store an indication, such as a flag, that the first light 420-1 is faulty. The controller 430 may therefore assess whether any of the lights 420 has an associated flag, and the controller 430 may be configured to only select, and diagnose, a light 420 which does not have an associated flag.

[0109] In a similar manner, the luminaire 500 may be configured to supply power from the second driving circuitry 410-2 to use the second light 420-2 to illuminate an area for the same length of time as when power was supplied from the first driving circuitry 410-1. After the selection time, the controller 430 of the luminaire 500 selects the first driving circuitry 410-1 to supply power to the second light 420-2.

[0110] This cyclic selection between the first driving circuitry 410-1 and the second driving circuitry 410-2 continues until one of the driving circuitries 410 becomes faulty, or until the remaining light 420-2 is faulty. In a similar manner as described above, the controller 430 may diagnose the driving circuitries 410 and the second light 420-2 prior to each use. When the luminaire 500 comprises one working driving circuitry and one working light, the luminaire 500 may be configured to transmit a preliminary critical fault alert indicating that the luminaire 500 no longer has redundancy capability (as it only has one working driving circuitry and one working light) and that maintenance may be required. A critical fault alert may be transmitted when no driving circuitries 410 and/or no lights 420 are operational.

[0111] FIG. 6 shows an example use of the luminaire 600. The illustrated luminaire 600 may be any of the example luminaires described above. In this illustrated example, the plurality of driving circuitries, the plurality of lights and the controller are wholly housed inside the luminaire 600.

[0112] In particular, the luminaire 600 is a lamppost luminaire. The luminaire 600 is specifically shaped to fit to a lamppost 610. The plurality of lights of the luminaire 600 are arranged inside the luminaire 600 such that, when powered, they substantially illuminate the same area of interest 620.

[0113] FIG. 6 illustrates an external user device 630 in proximity to the luminaire 600. As described above, the external user device 630 may communicate with the luminaire 600, for example, via a short-range communication protocol, such as NFC or Bluetooth®.

[0114] FIGs. 1, 2, 4 and 5 illustrates an example of a controller 130, 230, 430, 530 suitable for use in a luminaire 100, 200, 400, 500. Implementation of a controller 130, 230, 430, 530 may be as controller circuitry. The controller 130, 230, 430, 530 may be implemented in hardware alone, have certain aspects in software including firmware alone or can be a combination of hardware and software (including firmware).

[0115] As illustrated in FIGs. 1, 2, 4 and 5 the controller 130, 230, 430, 530 may be implemented using instructions that enable hardware functionality, for example, by using executable instructions of a computer program in a general-purpose or specialpurpose processor that may be stored on a computer readable storage medium (disk, memory etc) to be executed by such a processor.

[0116] The processor is configured to read from and write to the memory. The processor may also comprise an output interface via which data and/or commands are output by the processor and an input interface via which data and/or commands are input to the processor.

[0117] The memory stores a computer program comprising computer program instructions (computer program code) that controls the operation of the luminaire when loaded into the processor. The computer program instructions, of the computer program, provide the logic and routines that enables the apparatus to perform the methods illustrated in the accompanying Figs. The processor by reading the memory is able to load and execute the computer program.

[0118] The luminaire 100, 200, 400, 500 may comprise:

at least one processor; and
at least one memory including computer program code;
the at least one memory and the computer program code configured to, with the at least one processor, cause the luminaire 100, 200, 400, 500 at least to perform: selecting one light from a plurality of lights; selecting one driving circuitry from a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of the plurality of lights; and
supplying power to the selected light from the selected driving circuitries.

[0119] The luminaire 100, 200, 400, 500 comprises:

at least one processor; and
at least one memory including computer program code,
the at least one memory storing instructions that, when executed by the at least one processor, cause the luminaire 100, 200, 400, 500 at least to:

select one light from a plurality of lights;
select one driving circuitry from a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of the plurality of lights; and
supply power to the selected light from the selected driving circuitries.

[0120] As illustrated in FIGs. 1, 2, 4, 5, and 6, the computer program may arrive at the luminaire 100, 200, 400, 500 via any suitable delivery mechanism. The delivery mechanism may be, for example, a machine readable medium, a computer-readable medium, a non-transitory computer-readable storage medium, a computer program product, a memory device, a record medium such as a Compact Disc Read-Only Memory (CD-ROM) or a Digital Versatile Disc (DVD) or a solid-state memory, an article of manufacture that comprises or tangibly embodies the computer program. The delivery mechanism may be a signal configured to reliably transfer the computer program. The luminaire 100, 200, 400, 500 may propagate or transmit the computer program as a computer data signal.

[0121] Computer program instructions for causing a luminaire 100, 200, 400, 500 to perform at least the following or for performing at least the following:

selecting one light from a plurality of lights;
selecting one driving circuitry from a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of the plurality of lights; and
supplying power to the selected light from the selected driving circuitries.

[0122] The computer program instructions may be comprised in a computer program, a non-transitory computer readable medium, a computer program product, a machine readable medium. In some but not necessarily all examples, the computer program instructions may be distributed over more than one computer program.

[0123] Although the memory may be a single component/circuitry, it may be implemented as one or more separate components/circuitry some or all of which may be integrated/removable and/or may provide permanent/semi-permanent/ dynamic/cached storage.

[0124] Although the processor may be a single component/circuitry, it may be implemented as one or more separate components/circuitry some or all of which may be integrated/removable. The processor may be a single core or multi-core processor.

[0125] References to 'computer-readable storage medium', 'computer program product', 'tangibly embodied computer program' etc. or a 'controller', 'computer', 'processor' etc. should be understood to encompass not only computers having different architectures such as single /multi- processor architectures and sequential (Von Neumann)/parallel architectures but also specialized circuits such as fieldprogrammable gate arrays (FPGA), application specific circuits (ASIC), signal processing devices and other processing circuitry. References to computer program, instructions, code etc. should be understood to encompass software for a programmable processor or firmware such as, for example, the programmable content of a hardware device whether instructions for a processor, or configuration settings for a fixed-function device, gate array or programmable logic device etc.

[0126] The blocks illustrated in the accompanying FIGs 3A and 3B may represent steps in a method and/or sections of code in the computer program. The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied. Furthermore, it may be possible for some blocks to be omitted.

[0127] Where a structural feature has been described, it may be replaced by means for performing one or more of the functions of the structural feature whether that function or those functions are explicitly or implicitly described.

[0128] The recording of data may comprise only temporary recording, or it may comprise permanent recording or it may comprise both temporary recording and permanent recording. Temporary recording implies the recording of data temporarily. This may, for example, occur during sensing or image capture, occur at a dynamic memory, occur at a buffer such as a circular buffer, a register, a cache or similar. Permanent recording implies that the data is in the form of an addressable data structure that is retrievable from an addressable memory space and can therefore be stored and retrieved until deleted or over-written, although long-term storage may or may not occur.

[0129] The term 'comprise' is used in this document with an inclusive not an exclusive meaning. That is any reference to X comprising Y indicates that X may comprise only one Y or may comprise more than one Y. If it is intended to use 'comprise' with an exclusive meaning then it will be made clear in the context by referring to "comprising only one..." or by using "consisting".

[0130] In this description, the wording 'connect' and 'communication' and their derivatives mean operationally connected/in communication. It should be appreciated that any number or combination of intervening components can exist (including no intervening components), i.e., so as to provide direct or indirect connection/communication. Any such intervening components can include hardware and/or software components.

[0131] As used herein, the term "determine/determining" (and grammatical variants thereof) can include, not least: calculating, computing, processing, deriving, measuring, investigating, identifying, looking up (for example, looking up in a table, a database or another data structure), ascertaining and the like. Also, "determining" can include receiving (for example, receiving information), accessing (for example, accessing data in a memory), obtaining and the like. Also, " determine/determining" can include resolving, selecting, choosing, establishing, and the like.

[0132] In this description, reference has been made to various examples. The description of features or functions in relation to an example indicates that those features or functions are present in that example. The use of the term 'example' or 'for example' or 'can' or 'may' in the text denotes, whether explicitly stated or not, that such features or functions are present in at least the described example, whether described as an example or not, and that they can be, but are not necessarily, present in some of or all other examples. Thus 'example', 'for example', 'can' or 'may' refers to a particular instance in a class of examples. A property of the instance can be a property of only that instance or a property of the class or a property of a subclass of the class that includes some but not all of the instances in the class. It is therefore implicitly disclosed that a feature described with reference to one example but not with reference to another example, can where possible be used in that other example as part of a working combination but does not necessarily have to be used in that other example.

[0133] Although examples have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the claims.

[0134] Features described in the preceding description may be used in combinations other than the combinations explicitly described above.

[0135] Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

[0136] Although features have been described with reference to certain examples, those features may also be present in other examples whether described or not.

[0137] The term 'a', 'an' or 'the' is used in this document with an inclusive not an exclusive meaning. That is any reference to X comprising a/an/the Y indicates that X may comprise only one Y or may comprise more than one Y unless the context clearly indicates the contrary. If it is intended to use 'a', 'an' or 'the' with an exclusive meaning then it will be made clear in the context. In some circumstances the use of 'at least one' or 'one or more' may be used to emphasis an inclusive meaning but the absence of these terms should not be taken to infer any exclusive meaning.

[0138] The presence of a feature (or combination of features) in a claim is a reference to that feature or (combination of features) itself and also to features that

achieve substantially the same technical effect (equivalent features). The equivalent features include, for example, features that are variants and achieve substantially the same result in substantially the same way. The equivalent features include, for example, features that perform substantially the same function, in substantially the same way to achieve substantially the same result.

[0139] In this description, reference has been made to various examples using adjectives or adjectival phrases to describe characteristics of the examples. Such a description of a characteristic in relation to an example indicates that the characteristic is present in some examples exactly as described and is present in other examples substantially as described.

[0140] The above description describes some examples of the present disclosure however those of ordinary skill in the art will be aware of possible alternative structures and method features which offer equivalent functionality to the specific examples of such structures and features described herein above and which for the sake of brevity and clarity have been omitted from the above description. Nonetheless, the above description should be read as implicitly including reference to such alternative structures and method features which provide equivalent functionality unless such alternative structures or method features are explicitly excluded in the above description of the examples of the present disclosure.

[0141] Whilst endeavouring in the foregoing specification to draw attention to those features believed to be of importance it should be understood that the Applicant may seek protection via the claims in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not emphasis has been placed thereon.

Claims

1. A luminaire for area lighting comprising:

one or more lights;
a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of the one or more lights; and
a controller configured to select one of the plurality of driving circuitries, wherein the selected driving circuitry is operable to supply power to one of the one or more lights.

2. The luminaire of claim 1, wherein the controller is configured to select a different driving circuitry from the plurality of driving circuitries after a predetermined length of time from selecting a currently-selected driving circuitry.

3. The luminaire of any preceding claim, wherein the luminaire comprises a housing, and the controller is housed inside the housing of the luminaire, and wherein, optionally at least one of the one or more lights is at least partially housed inside the housing of the luminaire, and wherein, optionally, at least one of the plurality of driving circuitries is housed inside the housing of the luminaire.

4. The luminaire of any preceding claim, wherein the luminaire comprises a light sensor, and the controller is configured to cause the selected driving circuitry to supply power to one of the one or more lights when a light level sensed by the light sensor is below a threshold, and wherein, optionally, the controller is configured to stop the supply of power from the selected driving circuitry to the light when the light level sensed by the light sensor exceeds a threshold.

5. The luminaire of any preceding claim, wherein the luminaire comprises a transceiver, wherein the luminaire is configured to communicate with an external user device via the transceiver.

6. The luminaire of any preceding claim, wherein the luminaire comprises a plurality of lights and the controller is configured to select one of the plurality of lights, wherein the selected driving circuitry is operable to supply power to the selected light, and wherein, optionally, the controller is configured to select a different light from the plurality of lights after a predetermined length of time from selecting a currently-selected light.

7. The luminaire of claim 6, wherein the controller is configured to diagnose a currently-selected light of the plurality of lights and a currently-selected driving circuitry of the plurality of driving circuitries by monitoring power dissipation across the currently-selected light and the currently-selected driving circuitry, and wherein, optionally, the diagnosing comprises determining whether the currently-selected light and/or the currently-selected driving circuitry is faulty, and wherein, optionally, the controller is configured to select a different one of the plurality of driving circuitries than the currently-selected driving circuitry, based on the diagnosing of the currently-selected driving circuitry, and/or wherein the controller is configured to select a different one of the plurality of lights than the currently-selected light, based on the diagnosing of the currently-selected light, and wherein, optionally, the luminaire is configured to create a fault alert in response to the controller determining that one of the plurality of driving circuitries and/or one of the one or more lights is faulty, and wherein, optionally, the luminaire comprises a transmitter, and the luminaire is configured to control the transmitter to transmit the fault alert.

8. The luminaire of claim 6 or 7 when dependent on

claim 3, wherein the plurality of lights is at least partially housed inside the housing of the luminaire.

9. The luminaire of any one of claims 6 to 8 when dependent on claim 5, wherein the luminaire is configured to adjust a configuration of the controller, any one of the plurality of driving circuitries and/or any one of the plurality of lights based on information received from the external user device via the transceiver, wherein the configuration comprises at least one of:

a power consumption of the controller, driving circuitry and/or light;
a length of time for using a selected light; and
a length of time for using a selected driving circuitry.

10. The luminaire of any one of claims 6 to 9, wherein the luminaire is configured to compile data regarding the controller, plurality of driving circuitries and/or the plurality of lights.

11. A method for area lighting, the method comprising:

selecting one driving circuitry from a plurality of driving circuitries, wherein each driving circuitry is configured to control the supply of power to any one of one or more lights; and
supplying power to the light from the selected driving circuitry.

12. The method of claim 11, wherein the method comprises selecting one light from a plurality of lights, and supplying power to the selected light from the selected driving circuitry, and wherein, optionally, the method, prior to supplying power to the selected light from the selected driving circuitry, comprises:

determining whether the selected light from a plurality of lights is in a working condition; and
determining whether the selected driving circuitry from a plurality of driving circuitries is in a working condition.

13. The method of claim 12, wherein, if the selected light and/or the selected driving circuitry is/are determined to be faulty, the method comprises:

selecting another light from the plurality of lights and/or selecting another driving circuitry from the plurality of driving circuitries, and determining whether the selected another light and/or the selected another driving circuitry is/are in a working condition,
and wherein, optionally, the method comprises:

creating a fault alert, wherein the fault alert includes information relating to the determined faulty light and/or faulty driving circuitry; and
transmitting the fault alert.

14. The method of claim 12 or 13, wherein the method comprises:

stopping the supply of power to the selected light from the selected driving circuitry;
selecting a different light from the plurality of lights and determining that the selected different light is in a working condition;
selecting a different driving circuitry from the plurality of driving circuitries and determining that the selected different driving circuitry is in a working condition; and
if the selected different light and the selected different driving circuitry are determined to be in a working condition, supplying power to the selected different light from the selected different driving circuitry.

15. The method of claim 14, wherein the method comprises:

if the selected different light is faulty, selecting a further different light from the plurality of lights and determining that the selected further different light is in a working condition; and
if the selected different driving circuitry is faulty, selecting a further different driving circuitry from the plurality of driving circuitries and determining that the selected further different driving circuitry is in a working condition.

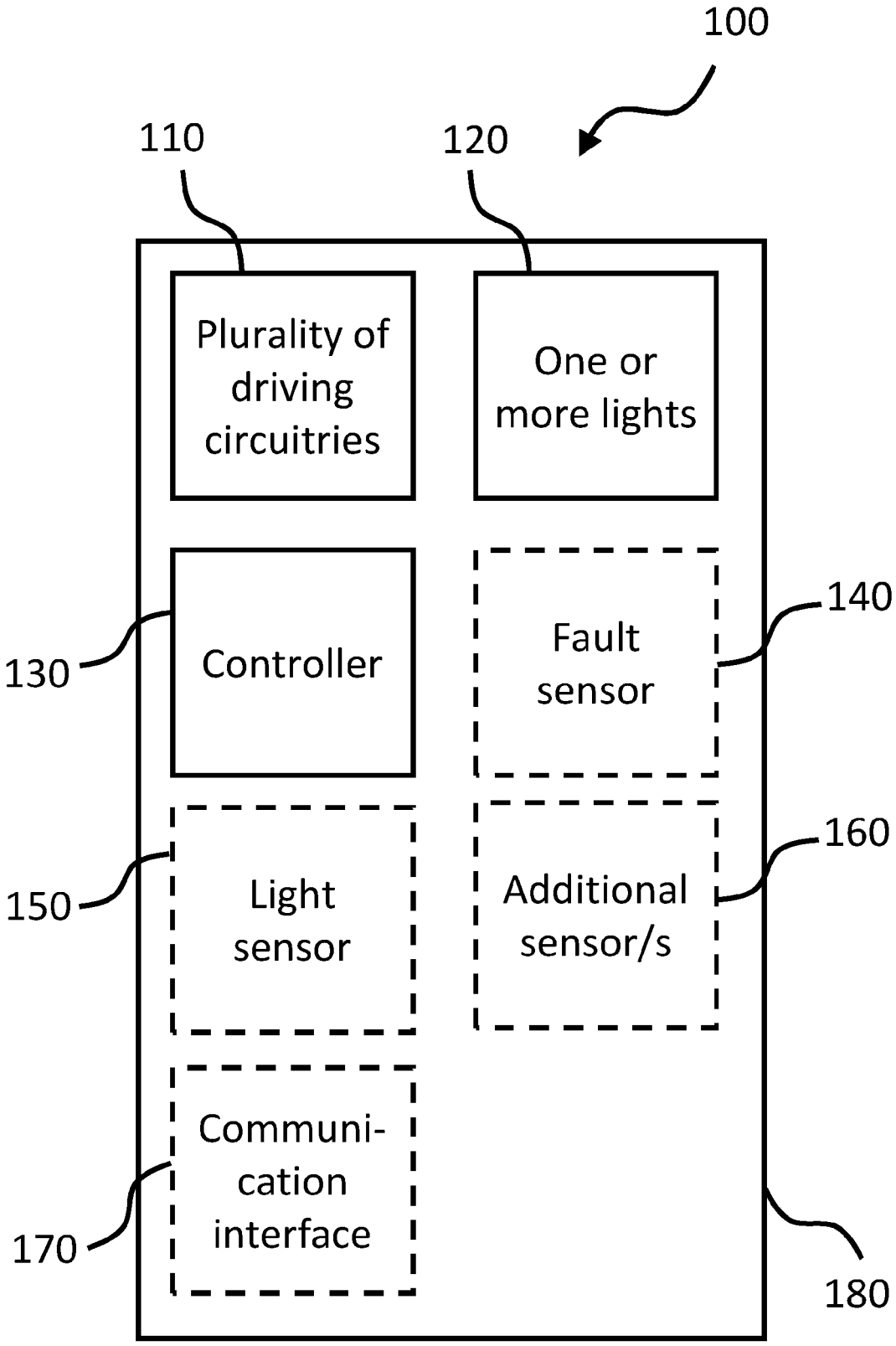
100
110
120
Plurality of driving circuitries
One or more lights
130
Controller
140
Fault sensor
150
Light sensor
160
Additional sensor/s
170
Communi-cation interface
180

FIG. 1A

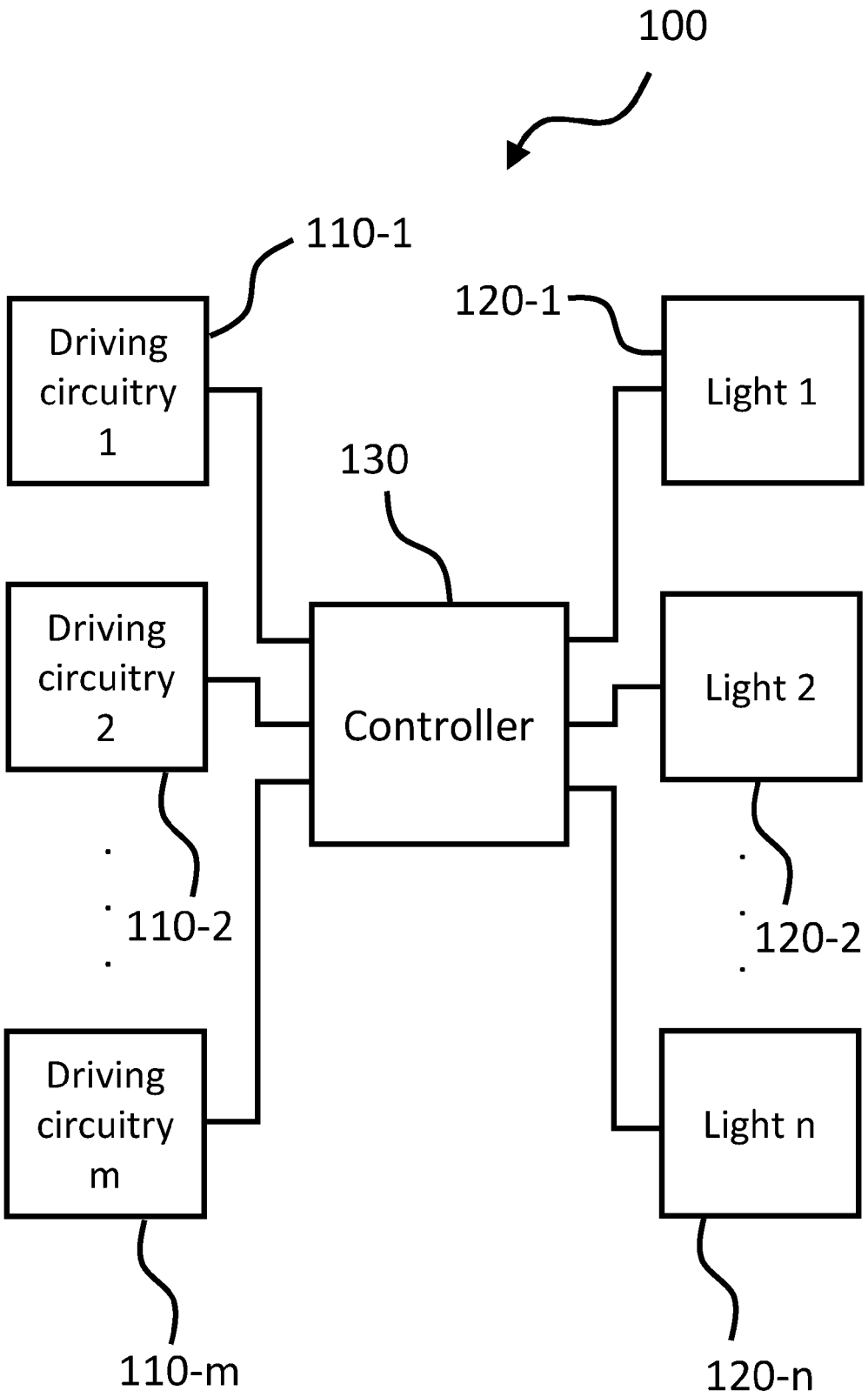
100
110-1
Driving circuitry 1
120-1
Light 1
130
Driving circuitry 2
Controller
Light 2
110-2
120-2
Driving circuitry m
Light n
110-m
120-n

FIG. 1B

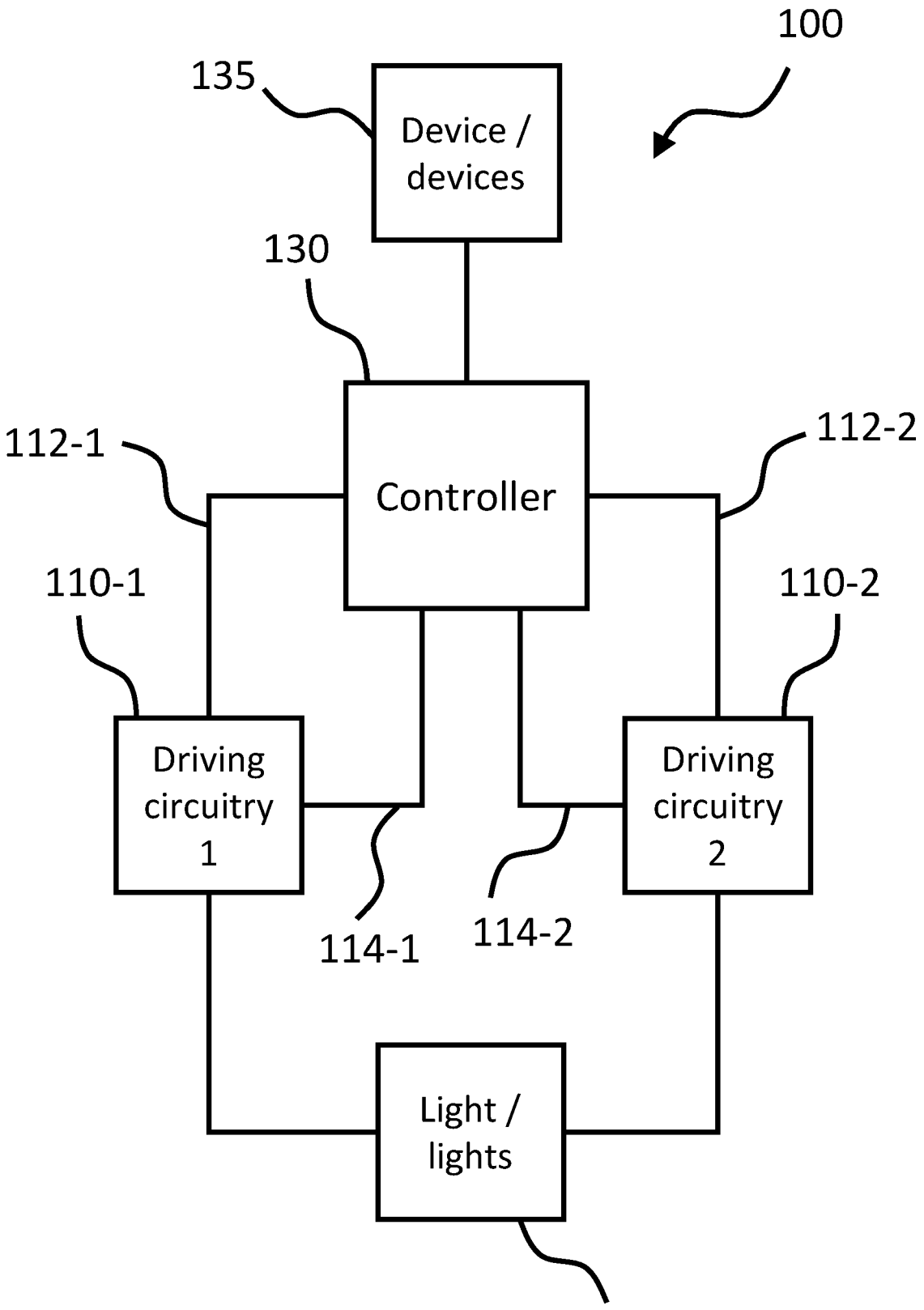
100
135
Device / devices
130
Controller
112-1
112-2
110-1
110-2
Driving circuitry 1
Driving circuitry 2
114-1
114-2
Light / lights
120

FIG. 1C

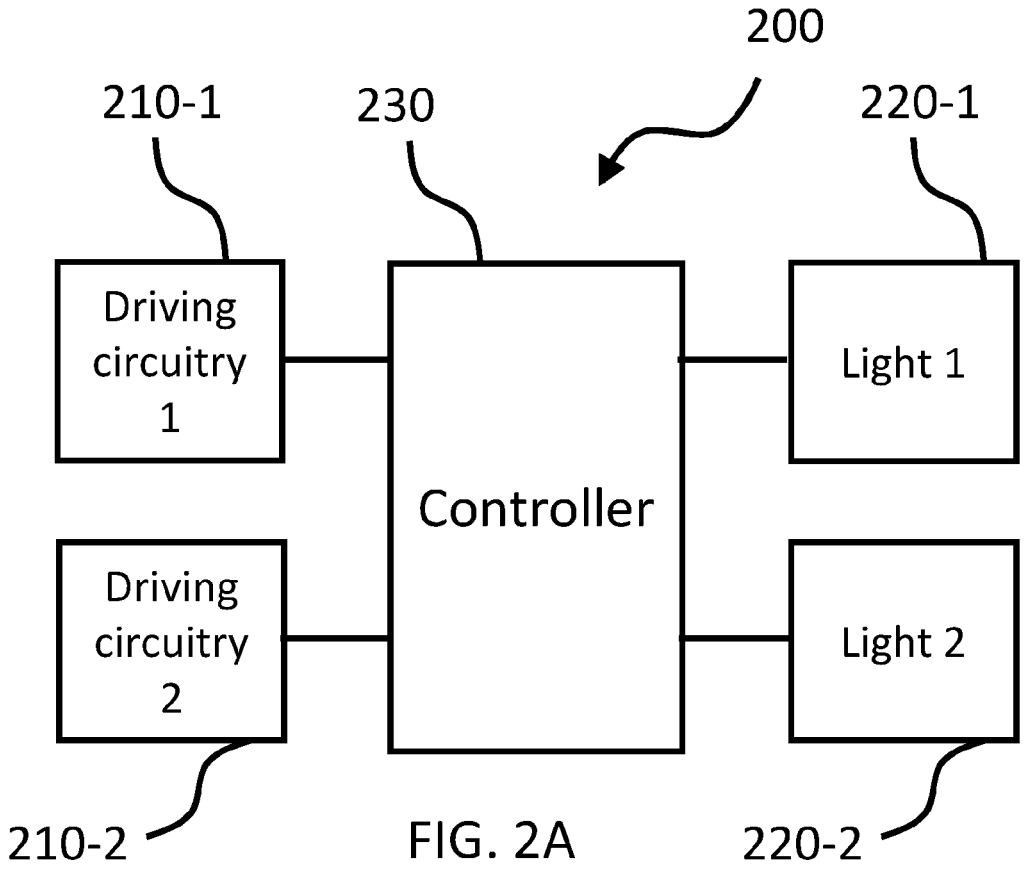
200
210-1
230
220-1
Driving circuitry 1
Controller
Light 1
Driving circuitry 2
Light 2
210-2
220-2

FIG. 2A

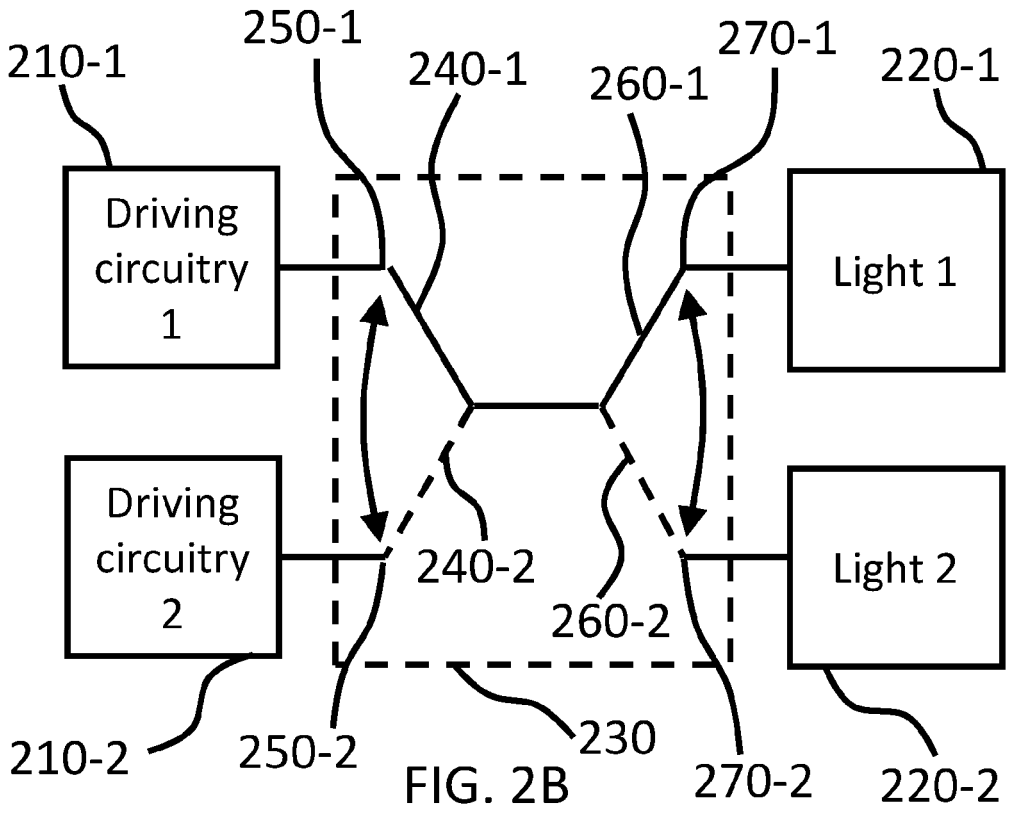
250-1
210-1
240-1
260-1
270-1
220-1
Driving circuitry 1
Light 1
Driving circuitry 2
240-2
260-2
Light 2
210-2
250-2
230
270-2
220-2

FIG. 2B

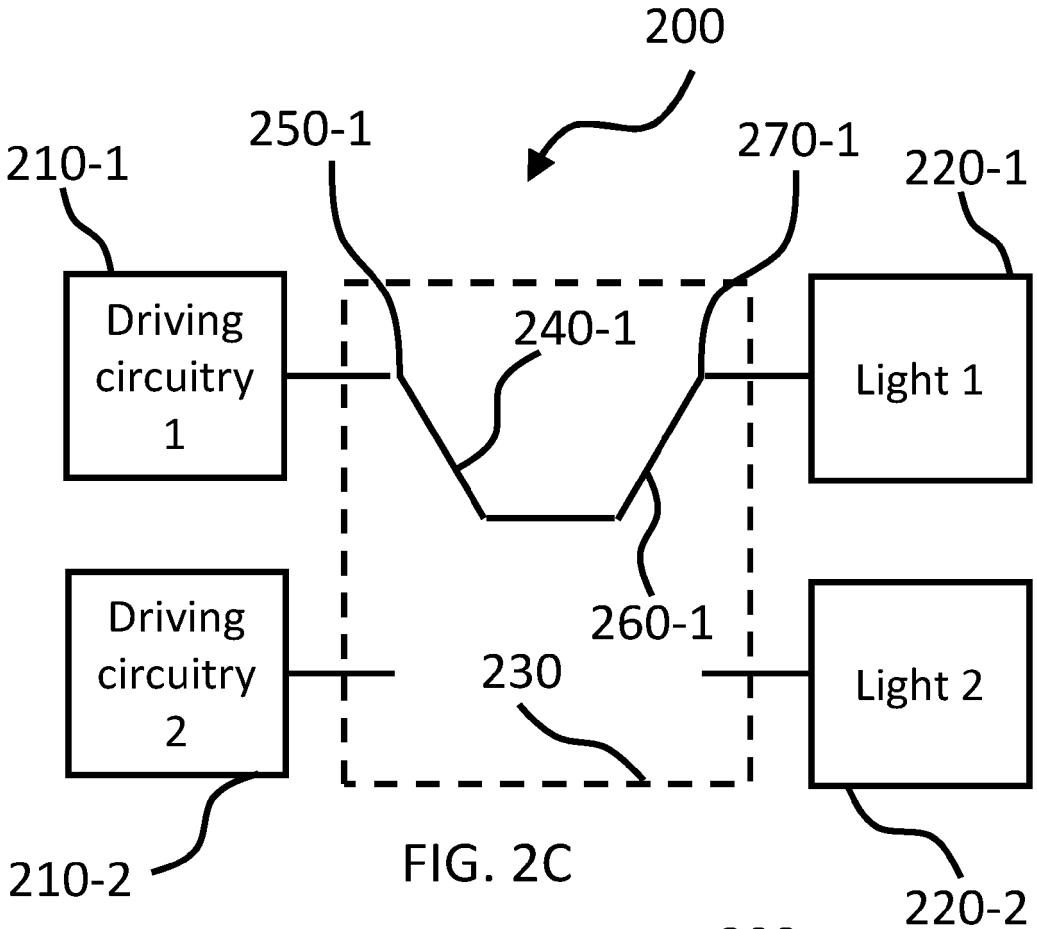
200
250-1
270-1
210-1
220-1
Driving circuitry 1
240-1
Light 1
260-1
Driving circuitry 2
230
Light 2
210-2
220-2

FIG. 2C

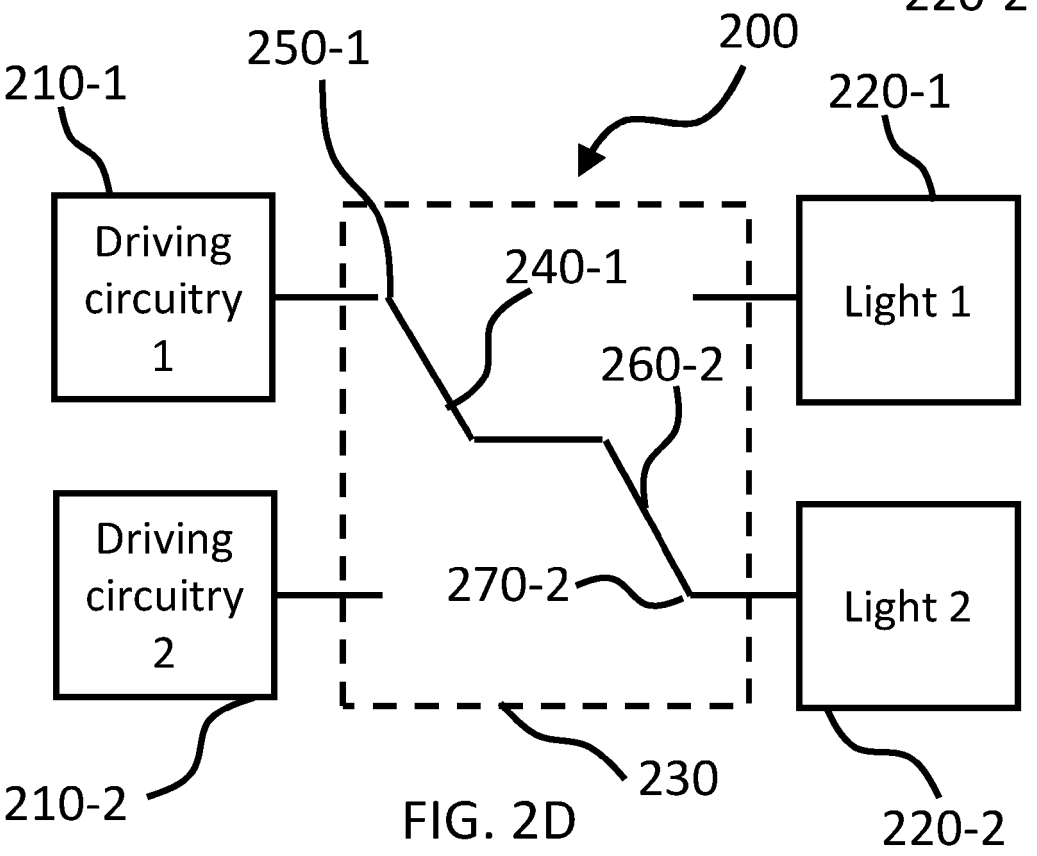
250-1
200
210-1
220-1
Driving circuitry 1
240-1
Light 1
260-2
Driving circuitry 2
270-2
Light 2
230
210-2
220-2

FIG. 2D

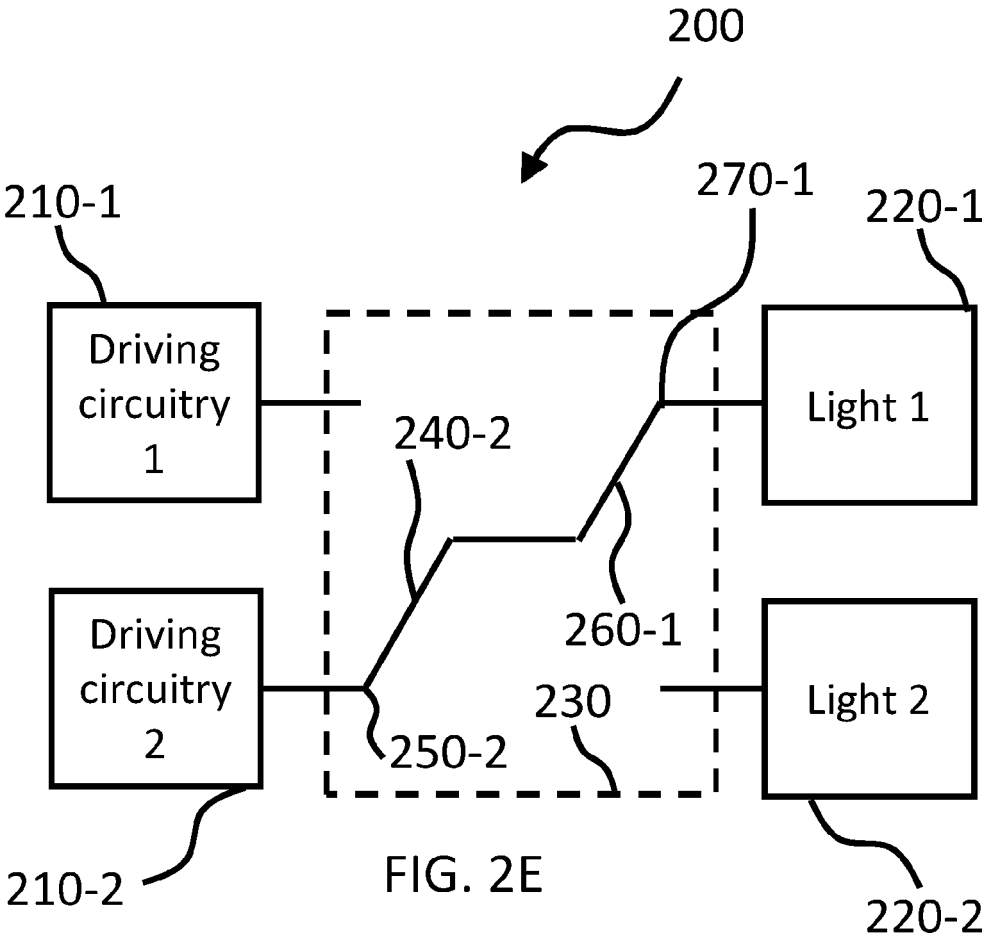
200
210-1
270-1
220-1
Driving circuitry 1
240-2
Light 1
Driving circuitry 2
260-1
230
250-2
Light 2
210-2
220-2

FIG. 2E

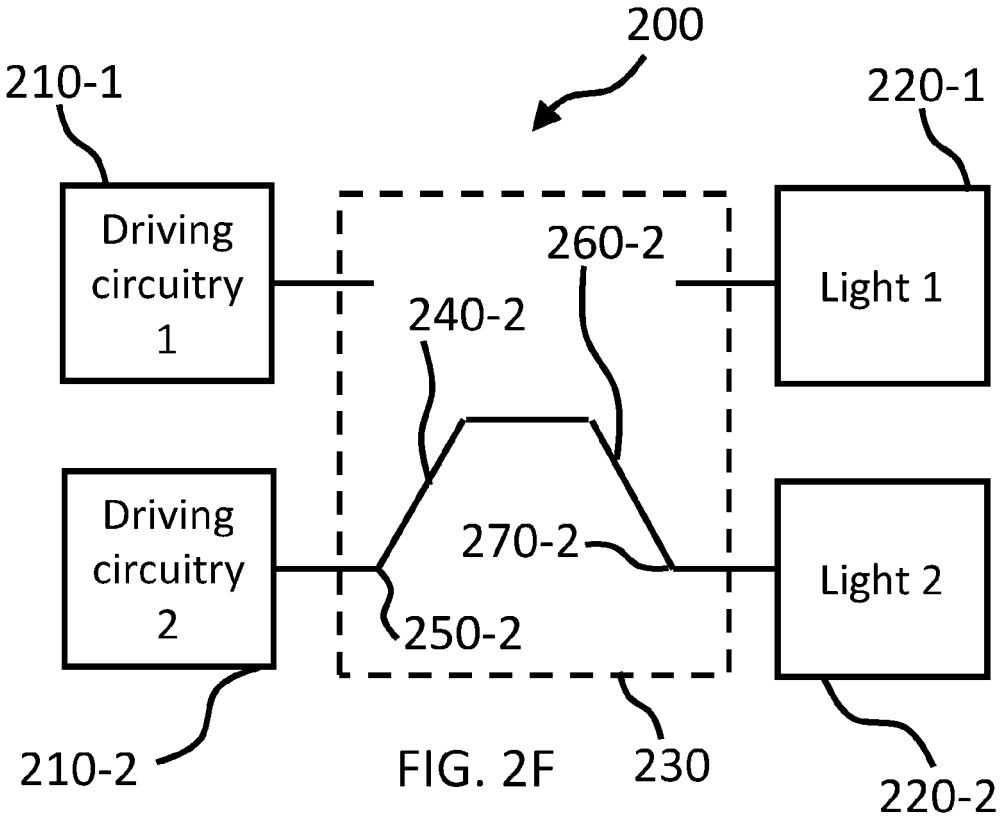
200
210-1
220-1
Driving circuitry 1
260-2
240-2
Light 1
Driving circuitry 2
270-2
250-2
Light 2
210-2
230
220-2

FIG. 2F

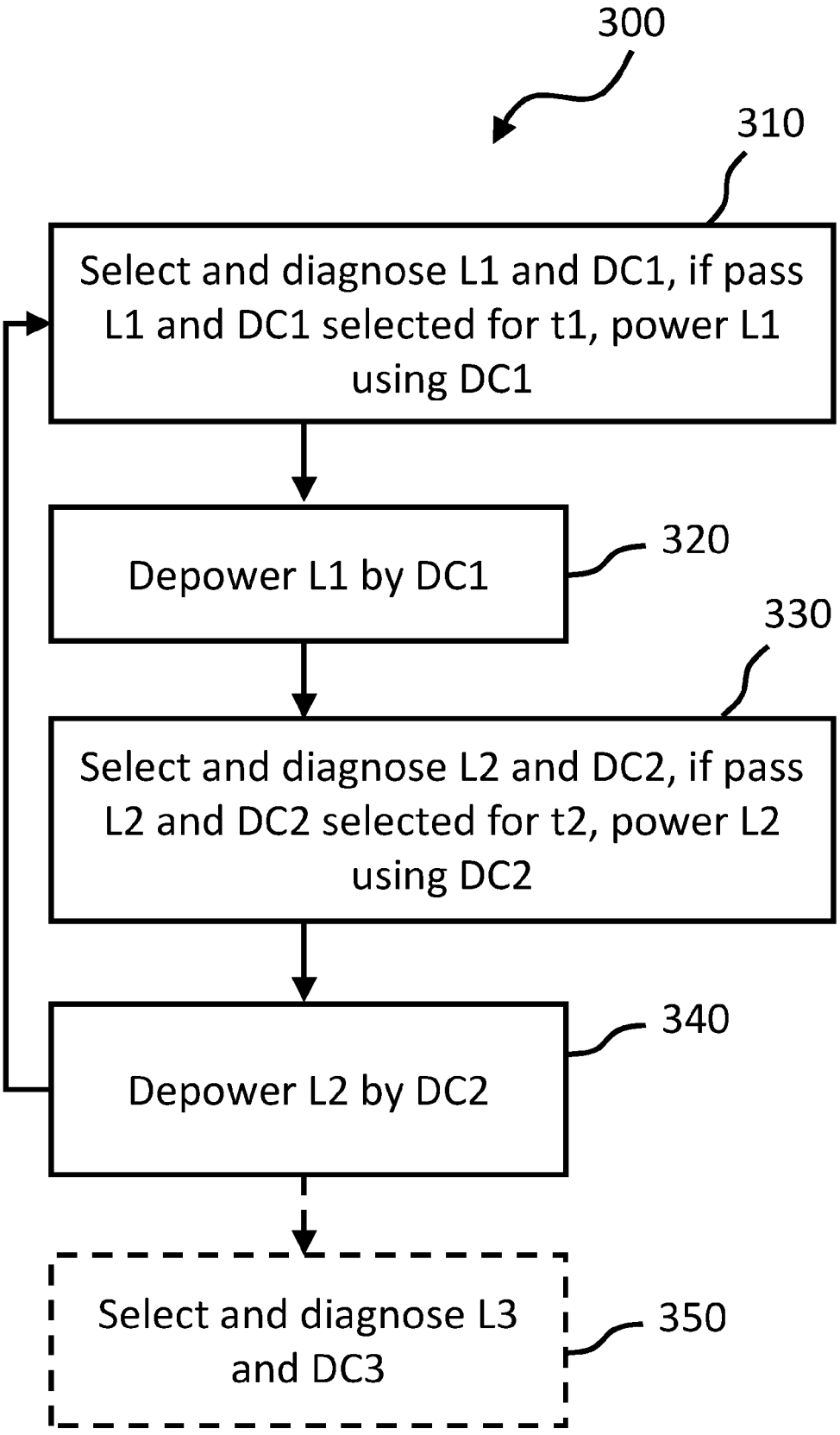
300
310
Select and diagnose L1 and DC1, if pass L1 and DC1 selected for t1, power L1 using DC1
Depower L1 by DC1
320
330
Select and diagnose L2 and DC2, if pass L2 and DC2 selected for t2, power L2 using DC2
Depower L2 by DC2
340
Select and diagnose L3 and DC3
350

FIG. 3A

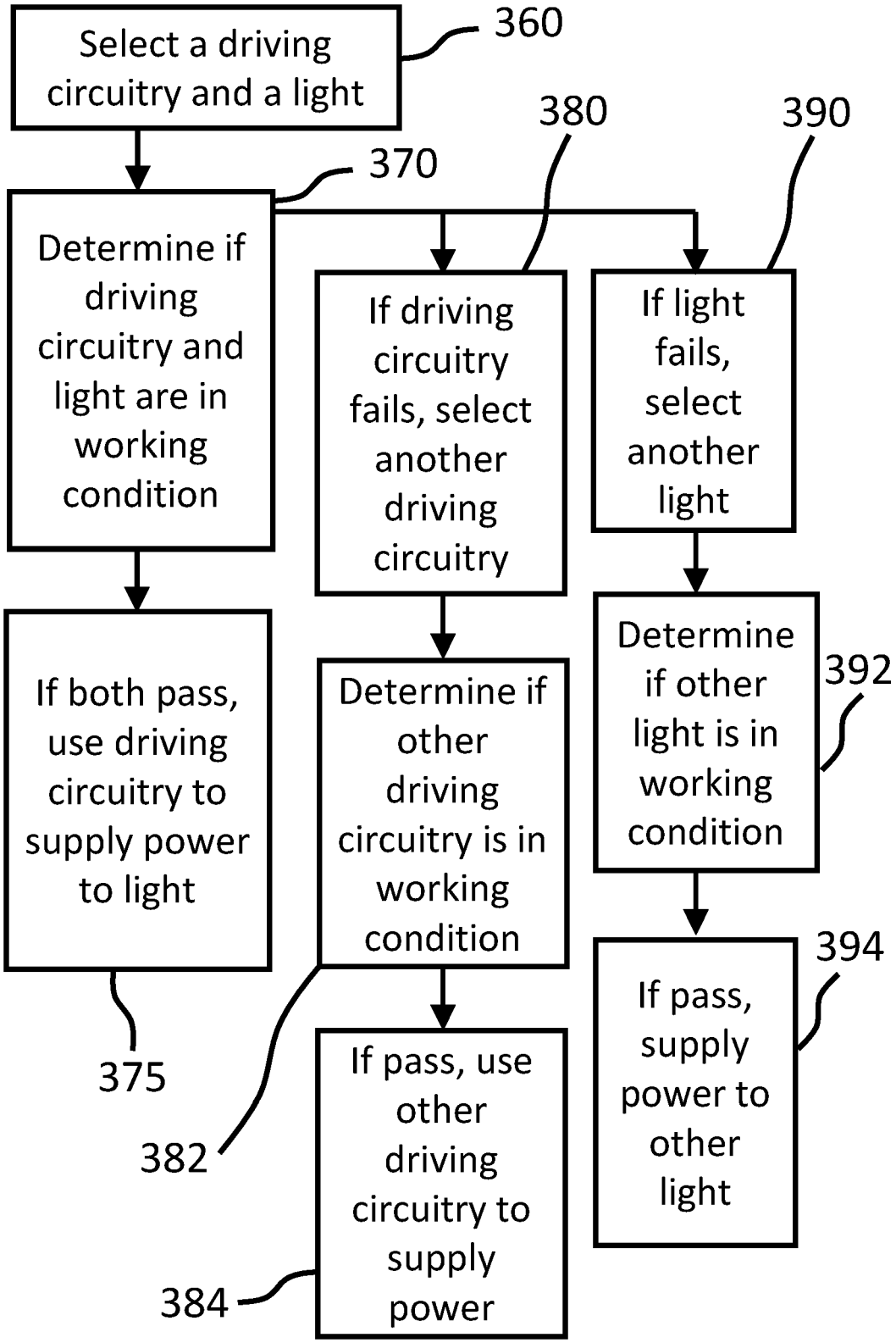
Select a driving circuitry and a light
360
Determine if driving circuitry and light are in working condition
370
If both pass, use driving circuitry to supply power to light
375
If driving circuitry fails, select another driving circuitry
380
Determine if other driving circuitry is in working condition
382
If pass, use other driving circuitry to supply power
384
If light fails, select another light
390
Determine if other light is in working condition
392
If pass, supply power to other light
394

FIG. 3B

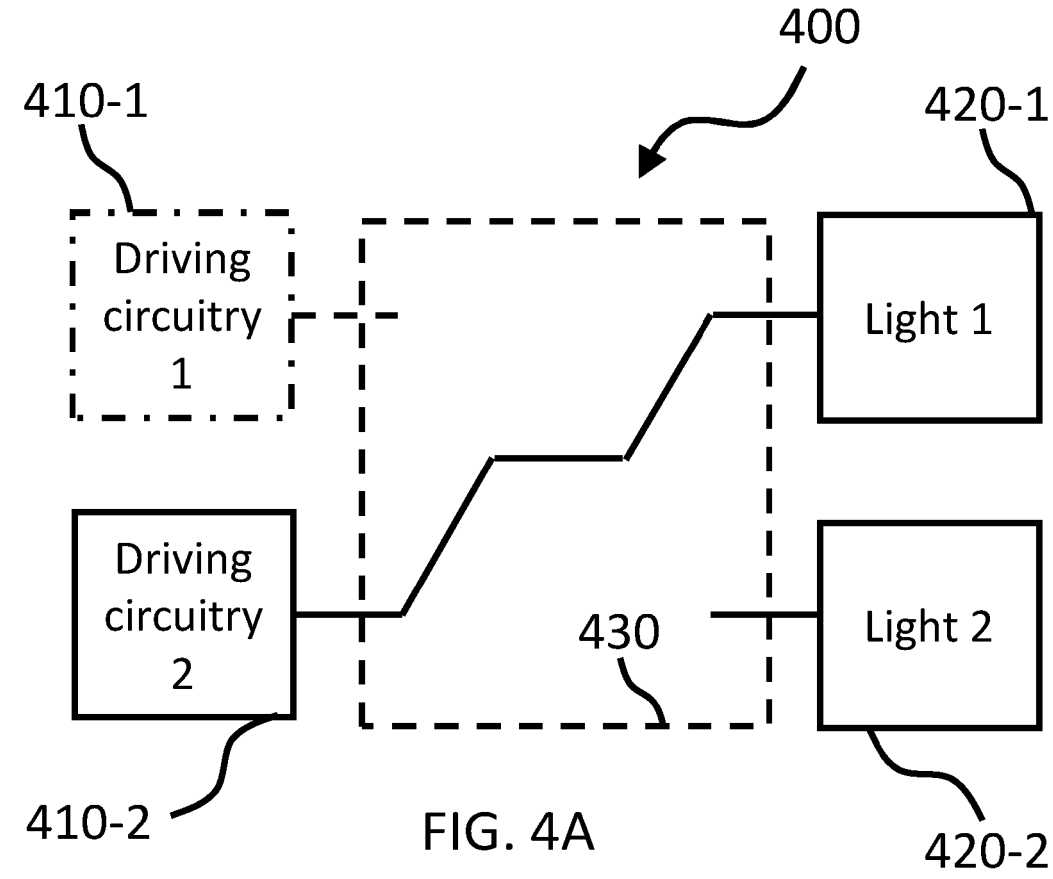
400
410-1
420-1
Driving circuitry 1
Light 1
Driving circuitry 2
430
Light 2
410-2
420-2

FIG. 4A

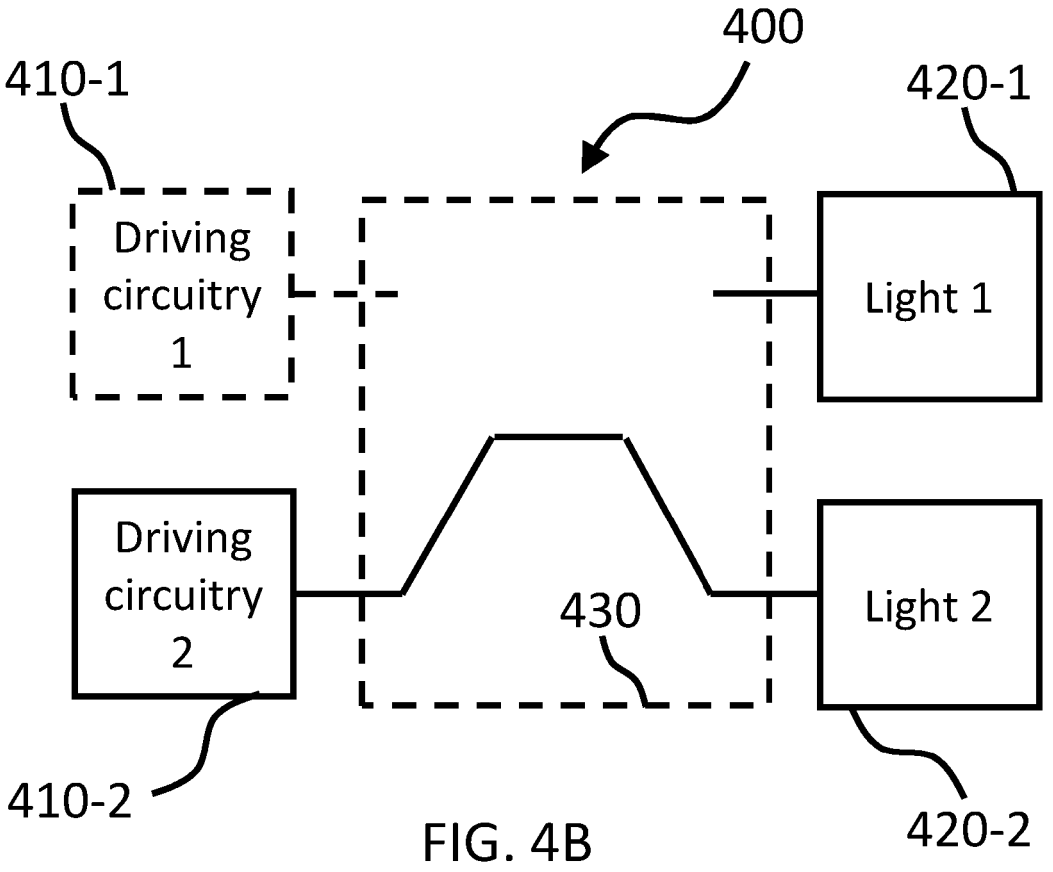
400
410-1
420-1
Driving circuitry 1
Light 1
Driving circuitry 2
430
Light 2
410-2
420-2

FIG. 4B

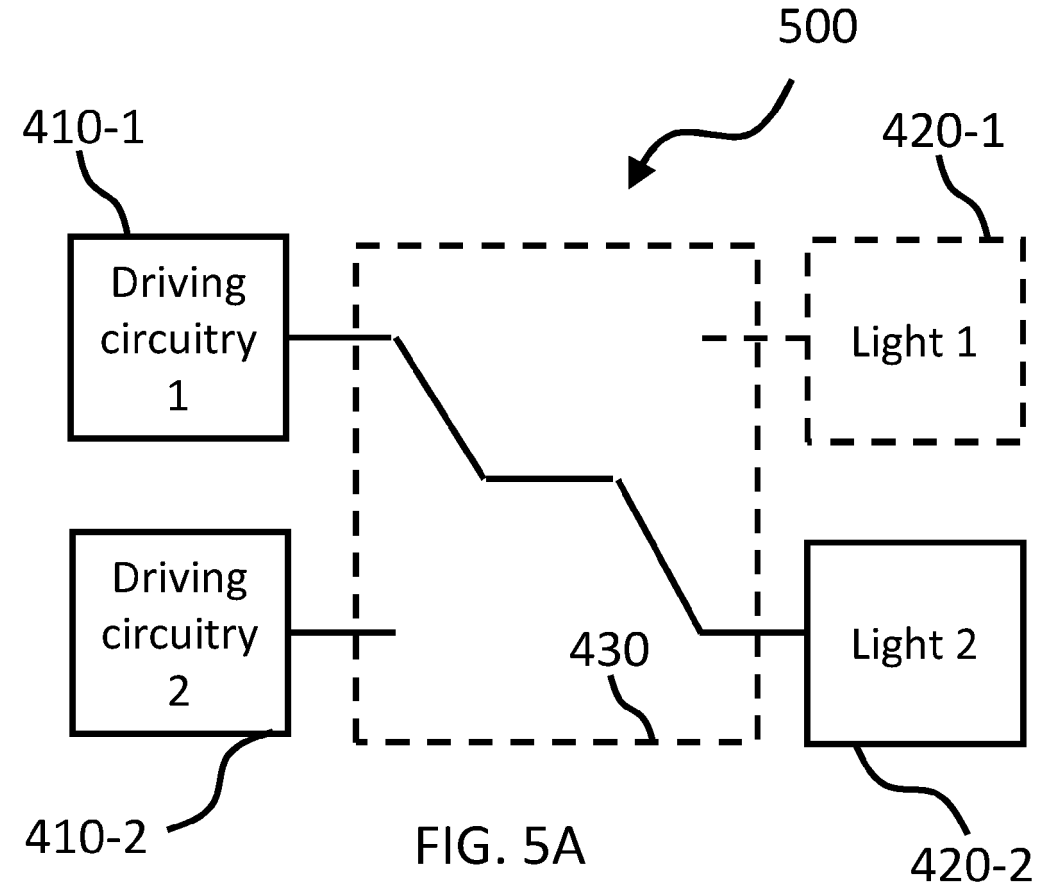
500
410-1
420-1
Driving circuitry 1
Light 1
Driving circuitry 2
430
Light 2
410-2
420-2

FIG. 5A

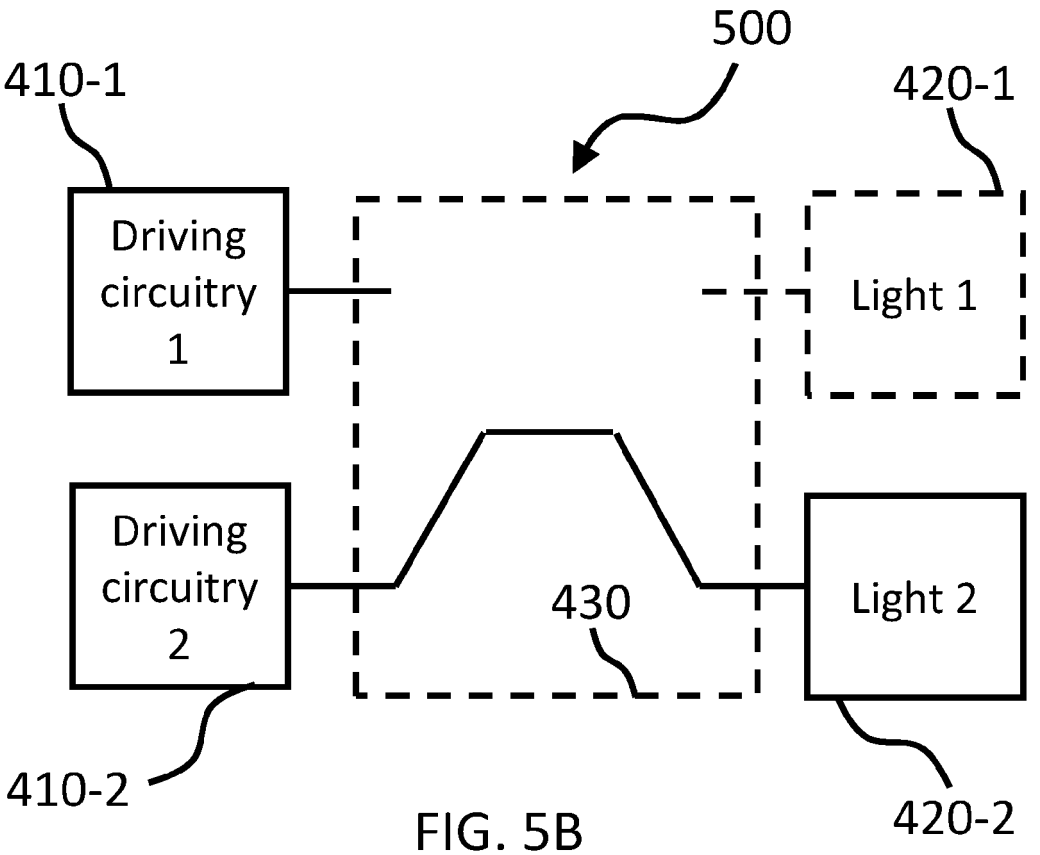
500
410-1
420-1
Driving circuitry 1
Light 1
Driving circuitry 2
430
Light 2
410-2
420-2

FIG. 5B

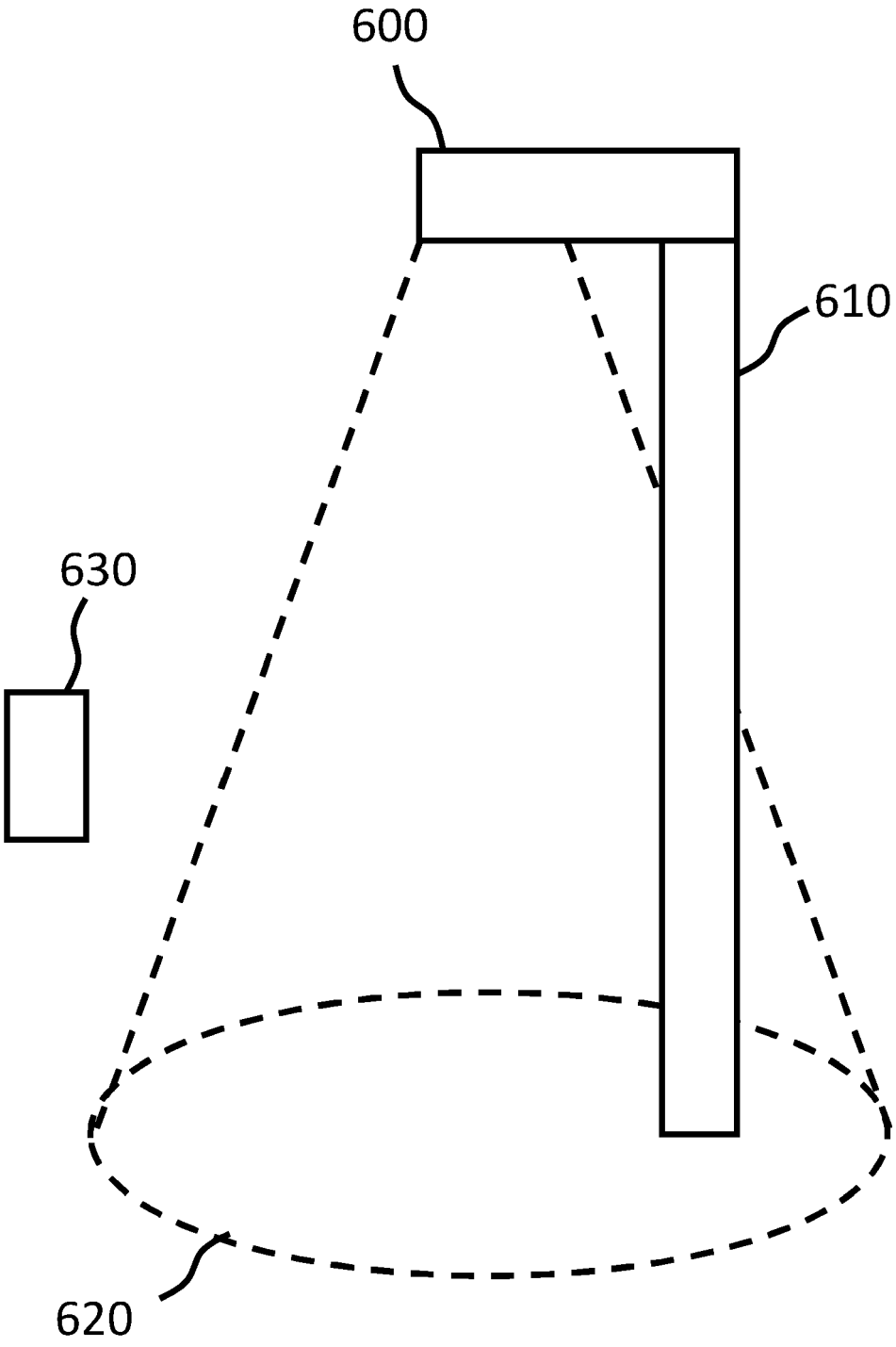

FIG. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 17 6101

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 11 102 861 B1 (ZOLOTYKH VALERIY [US] ET AL) 24 August 2021 (2021-08-24) * column 1, line 21 - column 4, line 34; figures 1-7 * * column 7, line 4 - column 9, line 34 *	1-3,5-15 4,5,7-15	INV. H05B45/50 H05B47/11 H05B47/19 H05B47/20
X Y	US 9 912 143 B1 (HOGAN BRIAN JOSEPH [US] ET AL) 6 March 2018 (2018-03-06) * column 1, line 55 - column 6, line 7; figures 1-4 *	1-3,6 7-15	
X Y	EP 3 843 507 A1 (ZUMTOBEL LIGHTING GMBH [AT]) 30 June 2021 (2021-06-30) * paragraph [0120] - paragraph [0143]; figure 1 *	1 5,9-11	
Y	US 2021/092822 A1 (GURJAR RAVINDRA VIRAJ [IN]) 25 March 2021 (2021-03-25) * paragraph [0001] - paragraph [0032]; figure 1 *	4,7-10, 12-15	
			TECHNICAL FIELDS SEARCHED (IPC) H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	1 October 2024	Henderson, Richard

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 17 6101

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-10-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 11102861 B1	24-08-2021	NONE	
US 9912143 B1	06-03-2018	CA 2996144 A1	27-08-2018
		US 9912143 B1	06-03-2018
EP 3843507 A1	30-06-2021	CN 114557135 A	27-05-2022
		EP 3843507 A1	30-06-2021
		EP 4062713 A1	28-09-2022
		US 2022346210 A1	27-10-2022
		WO 2021130011 A1	01-07-2021
US 2021092822 A1	25-03-2021	CA 3150093 A1	25-03-2021
		CN 114616925 A	10-06-2022
		EP 4011176 A1	15-06-2022
		US 2021092822 A1	25-03-2021
		US 2022264735 A1	18-08-2022
		WO 2021055139 A1	25-03-2021

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82